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ABSTRACT

This insulating building panel encloses a vacuum between two parallel plates that are separated at their edges by a post frame. Within the vacuum chamber, a support structure prevents
5 implosion of the panel due to suction pressure.

Glass plated vacuum panels form windows and steel plated panels cover other exterior surfaces, but materials used are not restricted to those mentioned.

When vacuum is applied, the plates engage the post frame in an
10 airtight manner with no other means of attachment between them except at an anchor point in each steel plated panel where plates are held to their post frames in order to maintain their relative positions to each other.

When the weather exposed plate of a steel plated panel expands
15 or contracts away from the anchor point in relation to the post frame due to fluctuating outside temperatures, the plate slides laterally over the post frame without obstruction and without forcing an accompanying movement of the post frame. Warping, which would otherwise render the panel impractical, is thereby
20 eliminated.

Stress upon support structures in steel plated panels due to thermally induced movement of weather exposed plates is also eliminated, spacers between plates being spheres that roll with such movement.

TITLE OF THE INVENTION

Vacuum Insulated Building Panel

BACKGROUND OF THE INVENTION

5 Early experimentation with vacuum insulated panels is evidenced
in U.S. Patent 948,541 (Coleman 1910). Later examples include
U.S. Patent 2,104,500 (Van Buren 1938) and U.S. Patent 5,168,674
(Molthen 1992). Patent searches conducted by personnel at the
Alberta Research Council and the University of Alberta, and
another by a registered patent agent, yielded little that bore
10 any similarity to the present panel. A vacuum is known to be
the best nonconductor of heat, but it has not been successfully
adapted to provide insulation in buildings.

Vacuum insulated building panels have generally consisted of an
enclosed space in which a combination of insulating material
15 and a partial vacuum impedes heat transfer between the interior
and exterior faces of such panels, the size of such panels being
small, fitting between studs or covering, at most, an inside
wall of a room. The faces and sides of these panels are rigidly
constructed, either in one piece or the faces are secured by
20 glue or other permanent means to a frame that forms the sides
of the panel. Within the enclosed space, a separate structure
supports the inside of the faces and sides of the panel to
prevent inward collapse of the panel due to suction pressure
of the vacuum.

The weather exposed face of a rigidly constructed panel expands and contracts due to wide temperature variations while the size of the other face changes little in comparison due to being maintained at close to building temperature. The panel warps, alternately in one direction then the other depending on the direction of temperature change, rendering it unusable.

A second previously unresolved problem caused by expansion and contraction of one face of a panel but not the other stresses the rigidly constructed support structures in other panels, said structures preventing the implosion of panels due to vacuum pressure by maintaining the separation of their faces. Under vacuum, support structures are continuously forced to adjust position relative to the expanding or contracting face of the panel, an exercise for which they are not designed.

The above problems do not exist in the present panel.

SPECIFICATION

Preliminary:

These panels are narrow in depth but unlimited in other directions, a single panel usually covering each plane surface on the outside of a house or other building. Above ground level they will cover walls, roofs, window openings and door openings. Panels may also line the inside of walls below ground level and underlie ground floors although there is little need for the latter in other than frigid zones.

- .0 The parts that enclose the vacuum in these panels are an exterior plate, an interior plate, and a post frame that separates the plates at their outer edges. The preferred material of plates in all but window panels is steel sheeting, that of window panels being glass. The material of post frames may be plastic or
- .5 wood. The plates overlap the inner edges of the post frame; they are not attached to the post frame by any permanent means such as glue or screws. The post frame and plates are held to each other at a single location in each panel, referred to herein as an "anchor point", by means of a bolt, the purpose of which is to
- 20 maintain the relative positions of post frame and plates to each other. The plates and post frame of each panel abutting the footing of a building have their anchor point at about midpoint of the bottom post of its post frame; panels covering roofs are anchored to the building frame and their post frames and plates are
- 25 held together by bolts at the centers of flat roofs or at midpoint of peak lines. The post frames of adjoining panels are constructed

in a contiguous manner whereby a single modified post serves both such adjoining panels; the contiguous post frame structure is erected slightly away from the building frame to accommodate contraction of that structure in cold weather. At such times as
5 panels are not under vacuum, wall and window panels are held in place by exterior framework components and exterior window frames, respectively, which are attached to post frames.

Within the vacuum chamber of each panel, a support structure counters the vacuum pressure that would otherwise cause the panel
10 to implode. The support structure in steel plated panels consists of a lattice framework that supports the post frame and of spheres that maintain separation of plates. The lattice framework is made up of equally spaced cross members that form squares, in the centers of which the spheres are positioned. In window panels,
15 separation of cross members is approximately halved, and in lieu of spheres, cross members thicken at their intersections to make contact with the glass plates. The material of support structures is the same as that of post frames so that a problem of expansion differential does not arise.

0 The vacuum chambers of all panels above ground level are interconnected by means of air passages through shared posts, forming in effect a single vacuum. Vacuum is thereby established in all panels simultaneously. Ports in interior plates of steel plated panels provide access to a vacuum pump which activates
15 automatically when needed to maintain desired pressure.

The most important feature of this panel is the elimination of

the cause of warping. This is achieved by using the suction pressure of the vacuum as the sole means of attachment between plates and post frame, thus replacing the one piece construction or permanent physical attachment of parts of other panels. A
5 bond that rivals the strength of the materials involved is created when vacuum is applied, while at the same time, lateral movement of a thermally expanding or contracting plate in relation to the post frame occurs without significant resistance.

A secondary feature of this panel is the use of spheres as spacers
) to maintain separation of plates in steel plated panels. The spheres roll without resistance to accommodate any movement of one plate in relation to the other. Unlike other panels, this panel recognizes problems caused by thermally induced expansion and contraction of weather exposed plates, and provides remedies.

Brief Descriptions of the Drawings

Drawings are for the purpose of illustration only and are not intended to in any way limit the scope of the invention to the particular embodiments shown, whereas:

5 FIGURE 1 is a perspective view of a vacuum insulated panel constructed in accordance with the teachings of the present invention.

FIGURE 2 is a front view of the vacuum insulated panel illustrated in FIGURE 1 showing the four corners in section.

10 FIGURE 3 is a side elevation view, in section, of the vacuum insulated panel illustrated in FIGURE 1.

FIGURE 4 is a side elevation view, in section, showing the configuration of the vacuum insulated panel illustrated in FIGURE 1 where it abuts the footing, prior to creating vacuum.

15 FIGURE 5 is the side elevation view shown in FIGURE 4, showing the modified configuration after vacuum has been created.

FIGURE 6 is a top plan view, in section, showing the configuration of two of the vacuum insulated panels illustrated in FIGURE 1 at an in-turning corner of a building, prior to
20 creating vacuum.

FIGURE 7 is the top plan view shown in FIGURE 6, showing the modified configuration after vacuum has been created.

FIGURE 8 is a top plan view, in section, showing the configuration of two of the vacuum insulated panels illustrated
25 in FIGURE 1 at an out-turning corner of a building, prior to creating vacuum.

FIGURE 9 is the top plan view shown in FIGURE 8, showing the modified configuration after vacuum has been created.

FIGURE 10 is a side elevation view, in section, showing the configuration of two of the panels illustrated in FIGURE 1
5 where they abut at an eave, prior to creating vacuum.

FIGURE 11 is the side elevation view shown in FIGURE 10, showing the modified configuration after vacuum has been created.

FIGURE 12 is a side elevation view, in section, showing the configuration of two of the vacuum insulated panels illustrated
10 in FIGURE 1 where they abut on a flat roof.

FIGURE 13 is a side elevation view, in section, showing the configuration of two of the vacuum insulated panels illustrated in FIGURE 1 where they abut on a peaked roof.

FIGURE 14 is a top plan view, in section, showing the
15 configuration where a preassembled panel covering a window opening is placed in position abutting a partly assembled wall panel in the initial stage of its incorporation into the wall panel.

FIGURE 15 is the top plan view shown in FIGURE 14,
20 illustrating the modified configuration after the window panel has been fully incorporated into the wall panel but prior to vacuum being created.

FIGURE 16 is the top plan view shown in FIGURES 14 and 15,
25 illustrating the modified configuration after vacuum has been created.

FIGURE 17 is a front elevation view, in section, of the vacuum insulated panel illustrated in FIGURE 1, showing the support structure within the vacuum chamber of a steel plated panel.

5 FIGURE 18a shows, in section, a cross sectional view of parts of the support structure within the vacuum chamber of a steel plated vacuum insulated panel as illustrated in FIGURE 1 which includes two spheres and a cross member of the lattice framework.

10 FIGURE 18b illustrates a cross sectional view, in section, of intersecting cross members of the lattice framework within the vacuum chamber of the steel plated vacuum insulated panel shown in FIGURE 18a.

15 FIGURE 19 is a front view of a vacuum insulated panel covering a window opening showing the support structure within the vacuum chamber of a glass plated panel.

20 FIGURE 20 is a cross sectional view of a vacuum insulated panel covering a window opening showing two intersections of cross members of the lattice framework which forms the support structure within the vacuum chamber of a glass plated panel.

FIGURE 21 illustrates a sling that holds each sphere in a steel plated panel in its correct location when the panel is not under vacuum and permits the sphere to roll when the panel is under vacuum.

Detailed Description of the Preferred Embodiment

Introductory:

It would seem that a building panel fitted to the exterior of a building and using a vacuum as its insulating medium has not
5 been successfully developed because of warping. While a vacuum is known to be the best of all insulators against conductive heat transfer, it must be contained in a stable structure in order to be practical. Warping, alternately in one direction then the other, occurs when the weather exposed face of a rigidly
3 constructed panel expands and contracts in response to fluctuating outside temperatures while the interior face retains its shape due to being maintained at a constant temperature.

In this panel, in which the parts that enclose the vacuum consist of a post frame that separates two parallel plates at
5 their edges, the problem of warping is eliminated by using the suction pressure of the vacuum as the sole means of attachment between said parts. This permits the expanding or contracting weather exposed plate to slide over the abutting surface of the post frame without forcing an accompanying movement of said post
3 frame. There is no threat to the structural integrity of the panel which would otherwise cause the panel to warp or fracture, the bond between post frame and plates remaining unaffected and secure.

Interior parts of the panel consist of a support structure
5 which counters the implosive pressure of the vacuum on the plates and on the frame. In other panels, a rigid support structure is stressed by any movement of one plate relative to the other, more severely the higher the degree of vacuum. In this panel there is no

such stress. Plate separation is maintained by spacers in the form of spheres that roll with any movement of one plate in relation to the other.

In detail:

5 There are two kinds of vacuum insulated panel, both
operating in the same manner but one having glass plates to
cover window openings and the other having steel plates to cover
all other areas on the outside of a building. Other differences
relate to their respective support structures, necessitated by
10 the difference in strength of their plate materials. Panels
may be referred to hereinafter according to their locations on
the building, such as wall panels, roof panels or window panels.
It should be understood that other suitable materials may be used
other than steel and glass in plates. In the drawings, steel
5 and glass plates are given separate reference characters.

The perspective view shown in FIGURE 1 shows a wall panel 10
in position on a footing 30, not restricted in width or height
as indicated by the scale of the drawing, the broken lines
indicating the inner edges of the post frame 14 which is partly
0 covered by exterior steel plate 16. The straight sections of the
post frame, referred to as posts, are 5 cms. in both width and
depth except where the post is modified in shape in order to
serve two adjoining panels. Steel plates, exterior and interior,
are about 3 mms. thick.

5 The full scale drawing in FIGURE 2 of the wall panel 10
illustrated in FIGURE 1 shows only the corners of the panel, the
exterior plate 16 covering the inner edges of the post frame 14

and extending to the footing 30. The posts of the post frame are attached to each other at their ends in an airtight manner.

FIGURE 3, a side elevation view, in section, of the panel illustrated in FIGURE 1, shows exterior plate 16 and interior plate 18 overlapping the top post of post frame 14, the enclosed area below said post and between the said plates being the vacuum chamber 24.

It is intended that all panels above ground level in a building be integrated into a single structure whereby a single post serves both panels wherever two panels adjoin. Because of this unified construction and the exposure of post frames to varying temperatures causing small expansions and contractions of the integrated post frame structure, the latter is erected slightly away from the building frame in order to accommodate any thermally induced inward movement. Below ground level, where outward expansion of post frames cannot be accommodated, post frames are not integrated with those above ground level and are erected separately.

FIGURES 4 and 5, respectively, illustrate the differing configurations before and after creation of vacuum at midpoint of the bottom post of post frame 14 where a wall panel 10 abuts the footing 30, said location also being the anchor point of the panel where plates 16 and 18 and the post frame are held in fixed relative positions to each other.

Referring to FIGURE 4, a clamping assembly consisting of bolt 48, nut 50 and two washers 52 holds the plates and post frame in close proximity to each other in preparation for creating vacuum. Lateral creeping of interior plate 18 is limited by the

diameter of the opening for the bolt in said plate, and lateral creeping of exterior plate 16, in which the opening for the bolt is larger, is limited by a washer 54 that is placed in said opening to take up space not occupied by the bolt. Clamping assemblies are positioned at about one meter intervals along the bottom posts of wall panels.

The separation of the panel from the building frame 60 is shown in FIGURE 4, facilitated by shims 62 as needed prior to vacuum being created, said shims being removed thereafter. The building frame features a steel beam 56 on its outside that extends along the footing, and a baseboard 58 on its inside which is removable for access to bolts. Circular openings are cut in the steel beam to accommodate the clamping assemblies.

Referring to FIGURE 5, once vacuum has been created, clamping assemblies and washers 54 as illustrated in FIGURE 4 are removed and replaced by bolt 28, nut 50 and exterior framework component 90. The outer framework component does not contact exterior plate 16 because of the difference in expansion factors.

Air passages through the modified posts of wall, roof and window panels interconnect the vacuum chambers of all such adjoining panels, enabling vacuum to be created in all such panels simultaneously. A vacuum pump, connected by means of a pipe grid that leads to access ports as needed through the interior plates of steel plated panels, is activated manually to create vacuum, and activates automatically thereafter to maintain desired pressure in the event of leakage.

FIGURES 6 and 7 both show the same view of two integrated panels at an in-turning corner of a building, FIGURE 6 showing the configuration preparatory to creating vacuum, and FIGURE 7 showing the modified configuration after vacuum is created.

5 In FIGURE 6, bolts 32, spaced at approximately one meter intervals along the modified post of post frame 14, and exterior framework component 36, assisted by clamping assembly bracer 34 and shims 62, compress the edges of interior plates 18 and exterior plates 16 of both panels 10 against the modified
10 post so that upon first removal of air from the panels, the plates immediately bond to said modified post. Also shown in this drawing is steel pillar 66, part of building frame 60, through which circular openings, indicated by broken lines, are cut to provide access to bolts. On the inside of the building
15 frame, cornerpiece 67 is removable to access bolts. Shims 62 are in place, separating the panels from the building frame.

Referring now to FIGURE 7, after vacuum has been created, all shims 62 and shims 64 at in-turning corners of the building, as shown in FIGURE 6, are removed and all bolts 32 are tightened
20 so that all exterior framework components 36 are brought into contact with their respective post frames as shown in FIGURE 7. Also shown in this drawing is an air passage 68 connecting the vacuum chambers of the two panels 10, but not positioned in conflict with a bolt as shown. Exterior framework component 36
25 holds exterior plates 16 in position at such times as vacuum is lost or released, as do other exterior framework components under eaves, above footings, and vertically at out-turning corners of buildings.

FIGURES 8 and 9, respectively, show the configurations at an out-turning corner of a building before and after vacuum is created. Shapes of most parts are necessarily quite different from those at in-turning corners but the performance of these modified parts, which include the post of post frame 14, an exterior framework component 74, clamping assembly bolt 70, replacement bolts 72, clamping assembly bracer 76 and building frame pillar 78, remain unchanged. Prior to creating vacuum, shims 64 maintain the separation of panels from the building frame and shims 62 assist in compressing exterior plates 16 to the post frame, all shims being removed after vacuum has been created. The clamping assembly bracers compress interior plates 18 to the post frame prior to creating vacuum and are removed after vacuum is created, unlike the bracers at in-turning corners which remain in position.

At an eave, FIGURES 10 and 11, respectively, show the configuration of adjoining wall and roof panels 10 before and after creating vacuum. The shape of the modified post of post frame 14 is dictated by the angle of the roof slope. In FIGURE 10, the clamping assemblies, which are spaced at about one meter intervals along the modified post of post frame 14, consist of bolts 48, nuts 50 and washers 80 which are the same as those used at the footing except that washers are modified in order to make contact with the post frames. In FIGURE 11, the clamping assembly shown in FIGURE 10 has been replaced by bolt 28, nut 50 and exterior framework component 84, the latter not making contact with exterior plate 16 because of differing expansion factors. Openings cut in steel beam 82 and a sufficiently deep attic space

above ceilings provide access to bolts. Shims 64 are removed after vacuum is created.

FIGURE 12 depicts the configuration whereby two adjoining panels 10 combine to cover a flat roof. The two panels share an unmodified post 14 of the integrated post frame structure at their juncture, and the abutting edges of both the exterior plates 16 and interior plates 18 are welded to each other. An exterior framework component 88 covers the welded edges of the two exterior plates and a steel girder 86, part of building frame 60, underlies the welded edges of the two interior plates. A bolt 92, passing through the exterior framework component, the shared post of the two panels, the welded edges of the exterior and interior plates and the steel girder, anchors all said parts to the building frame.

FIGURE 13 illustrates the configuration of two adjoining panels 10 at the peak of two sloping roof sections. Exterior plates 16 and interior plates 18 of the two panels are welded together at their abutting edges, and bolt 94 anchors exterior framework component 96, post frame 14, and the said plates to steel girder 98 which is part of building frame 60.

Three stages in the erection of window panels are shown in FIGURES 14, 15 and 16. Glass plated window panels are incorporated within steel plated wall panels, such wall panels being referred to as host panels. The posts of post frames shared by window panels and their host wall panels are not linked to the unified post frame structure of steel plated wall and roof panels. One or more air passages, as needed, through each post of post frames that is shared by two steel plated

panels connects the vacuum chambers of such panels so that in effect, the vacuums in all such interconnected panels form a single vacuum, but each window panel is interconnected with its host panel by means of a single air passage through the bottom horizontal post of its post frame. This, by a certain means, permits a lesser degree of vacuum to be established in glass plated window panels than in steel plated panels.

FIGURE 14 shows, in section, a post 14 of a fully assembled glass plated window panel 12 being fitted into a prepared opening in interior plate 18 of its host steel plated wall panel 10, the interior plate having been installed in its permanent position in relation to building frame 60. The said post is slightly modified to accommodate the thicker exterior plate 20 and interior plate 22 of the window panel. The clamping assembly shown, consisting of bolt 48, nut 50 and washers 80, serves until the host wall panel has been fully assembled.

FIGURE 15 shows the configuration in which a fully assembled wall panel 10 adjoins a window panel 12 preparatory to creating vacuum. The clamping assembly washers 80, shown in FIGURE 14, have been replaced by clamping assembly washers 52.

By way of introducing the support structures that prevent implosion of panels due to vacuum pressure, the support structure in a steel plated panel consists of a lattice framework which supports the post frame against vacuum pressure and of spacers in the form of, and herein referred to as, spheres which maintain the separation of exterior and interior plates against said vacuum pressure. Due to the comparative strengths of steel and glass plate materials, anticipated separation of cross members

in steel and glass plated panels is 60 cms. and 30 cms., respectively. Spheres are suspended in slings at the centers of squares formed by cross members in steel plated panels. In glass plated panels, spheres are not used to maintain plate separation. Instead, the cross members of support structures thicken at their intersections to make contact with plates, thereby maintaining separation of said plates. Projections from the lattice framework in steel plated panels at intersections of cross members maintain the position of said framework near the center of the vacuum chamber.

FIGURE 16 shows the configuration where a window panel and its host wall panel adjoin after vacuum has been created. The clamping assembly shown in FIGURE 15, consisting of bolt 48, nut 50 and washers 52, is replaced by bolt 100 and outer window frame 102. Shims 64 are removed and interior window casing 104, which is removable to access bolts, is added. Also shown in this drawing, indicated by broken lines, are a cross member of the lattice framework 106 within the vacuum chamber 24 of the host wall panel 10 and a cross member of the lattice framework 108 within the vacuum chamber 26 of the window panel 12.

On a scale of 1 = 10, FIGURE 17 illustrates, in section, a support structure within the vacuum chamber of a steel plated panel. Cross members of the lattice framework 106 form squares or near squares, in the centers of which spheres 112 are suspended between cross members of the lattice framework in a manner that permits them to roll with thermally induced movement of one plate in relation to the other after vacuum is applied. Projections 114 protrude from each side of cross members at their intersections.

On a scale of 1 = 3, FIGURE 18a illustrates, in section, a cross section of a steel plated panel 10 showing exterior plate 16, interior plate 18, vacuum chamber 14, two spheres 112, and a cross member 106 of the lattice framework.

5 On a scale of 1 = 3, FIGURE 18b illustrates, in section, a cross sectional view of the same panel as that in FIGURE 18a but at a location that shows the two projections 112 on each of two cross members 106, and also shows a third cross member 106 that attaches at right angles to and extends between the two first
0 mentioned cross members.

On a scale of 1=5, FIGURE 19 shows, in section, the support structure within the vacuum chamber of a glass plated window panel, the broken lines indicating the outer edges of exterior glass plate 20. The small squares at intersections of cross
5 members 108 represent the thickened portions 110 of said cross members that make contact with and maintain the separation of exterior and interior plates.

On a scale of 1 = 2, FIGURE 20 illustrates a side view of sections of a cross member of the lattice framework 108 in a
0 window panel. Also shown are the thickened portions 110 of two intersecting cross members which maintain the separation of exterior and interior glass plates 20 and 22 respectively.

On a scale of 1 = 5, FIGURE 21 illustrates a sling 116 which holds each sphere in a steel plated panel in its correct
15 location at such times as the panel is not under vacuum, the sling consisting of a girdle 118 that loosely encircles the sphere so that the sphere can roll without impediment, two lengths of cord 122 that loop around the girdle and lead in

opposite directions to coil springs 120, and second lengths of cord 124 that connect the coil springs to cross members of the lattice framework 106, the said opposite directions lining up with the anchor point of the panel. When the panel is under vacuum, the slings allow the spheres to roll with any thermally induced contraction or expansion of one plate in relation to the other plate.

Other details:

The means by which a lesser degree of vacuum pressure can be established in window panels than in their host panels is as follows. When desired pressure is attained in window panels, a steel ball is moved by magnet to plug the air passage through its bottom post. Renewed operation of the vacuum pump creates greater pressure in the host panel, firmly seating the steel ball in the top of the air passage, and preventing further increase in pressure in the window panel.

It should be noted that while glass plated panels will not insulate against solar heating, they will perform as well as steel plated panels against conductive heat transfer.

The vacuum chambers of all steel plated panels are connected either directly or indirectly via air passages between adjacent panels to a vacuum pump by means of ports through interior plates and a pipe grid. If vacuum is lost or released for any reason, accidental or intentional, the procedure will be to apply clamping assemblies as needed along all edges of panels, effect needed repairs or servicing, then recreate vacuum, after which clamping assemblies are removed or adjusted as required.

In the event of loss of vacuum in a window panel due to a fractured plate, the plugged air passage to the host panel will

prevent loss of vacuum in the rest of the integrated system. When the fractured plate has been replaced, vacuum in the rest of the system will need to be released, then renewed throughout. Insulation in the rest of the system will have been retained while awaiting repair.

In preparation for creating or recreating vacuum, whether during construction or after vacuum has been released or lost for any reason, all interior steel plates are separated from the building frame by shims, and all wall and window panel plates, exterior and interior, are held sufficiently close to their respective post frames by clamping assemblies in various configurations as needed at one meter intervals along their edges, thereby ensuring airtight couplings of all plates to post frames when vacuum is applied. In roof panels, if plates and post frames are not positioned in close enough proximity by the weight of their exterior plates, additional weight is applied temporarily. After vacuum has been created, shims are removed to give the integrated post frame room to contract in cold weather, added weights are removed from the roof, and clamping assemblies are modified, removed or replaced as necessary in order to permit plates to freely expand and contract in relation to post frames due to fluctuating outside temperatures. Changes in clamping assemblies after vacuum has been created include positioning of outer window frames and other exterior framework components.

The anticipated procedure for assembling window panels and incorporating them into wall panels is as follows:
The glass exterior plate will be laid out above a work bench or other flat surface, elevated to later accommodate clamping

assemblies;

the post frame will be positioned on the plate, overlapping the edges of said plate;

vertical cross members of the lattice framework, then horizontal

5 sections of same that fit between the vertical cross members, attached in fixed positions, will follow;

the interior plate, which is identical to the exterior plate, will then be positioned, overlapping the post frame;

clamping assemblies will be temporarily installed to hold plates
10 to the post frame until vacuum has been created;

the fully assembled window panel will be installed in its permanent position, resting on vertical cross members of the lattice framework of its host panel which will have been erected to window level, and upon such instalation, the window

15 panel will be held in position by replacing interior washers 80 with washers 52;

the remainder of the lattice framework in the host panel will then be erected;

spheres will be positioned in the squares formed by cross members
20 of the lattice framework of the host wall panel;

the exterior plate of the host wall panel will be positioned and secured by clamping assemblies along its outer edges, and on the outside of the window panel post frame, washers 80 will be replaced by washers 52; and

25 upon creation of vacuum, clamping assemblies along the perimeters of window panels are replaced by bolts 100 and outer window frames 102.

Exterior framework components, which include outer window frames, follow the edges of all exterior plates of wall and window panels, their main purpose being to prevent the collapse of said plates if vacuum is lost due to accident or released for servicing or repair. They also provide a degree of protection to edges of panels from weathering.

Clamping assemblies, in configurations as needed, are installed at one meter intervals along the edges of all wall and window panels, their purpose being to hold both exterior and interior plates in position against post frames preparatory to initially creating vacuum and to recreating vacuum after it has been lost or released for any reason. At building corners, exterior framework components form integral parts of clamping assemblies.

All plates, steel or glass, exterior or interior, are provided space to expand or contract due to temperature fluctuations.

Steel plated panels can be adapted for use in constructing doors, requiring flexible air conduits to connect their vacuum chambers to those of wall panels.

It should be understood that modifications may be made to the embodiments shown in drawings and to any and all aspects of this invention as they have been represented in descriptions herein.

Proposed Construction Agenda

1. A vacuum pump will be permanently installed in the building.
A pipe grid, directly or indirectly connecting the vacuum pump
to all steel plated panels will be laid out through the building
5 frame, and ports, through which air will be withdrawn to create
vacuum, will be positioned in interior steel plates.
2. Steel sheeting will be delivered to building sites in custom
ordered transportable sections.
Sections of steel sheeting, handled by mobile crane, will be
10 welded together on conveniently located jigs to form correctly
sized interior plates.
3. Temporary shims will be attached to the building frame to
provide adequate spacing between panels and the building frame
above ground level to allow for any contraction of the integrated
15 post frame in cold temperatures.
Below ground level, interior plates of separate panels, their
post frames not integrated with those above ground level, will be
positioned flush with, anchored to, and temporarily attached to
the foundation wall.
- 20 4. When assembled, the interior plate of each wall panel, with
its jig, will be raised into position by crane and temporarily
attached to the building frame, after which the jig will be lowered
to the ground to await piecing together and erection of the
exterior plate.
- 25 Interior plates of roof panels may be assembled and raised in a
similar manner, or sections may be assembled in their permanent

positions on the roof, completed plates being anchored at the center of the roof, their abutting edges being welded together.

5. With all steel interior plates in place, a unified post frame structure following and overlapping the outer edges of said plates
5 above ground level will be erected and temporarily attached as needed to the building frame.

Below ground level, post frames following the outer edges of the interior plates of separate panels will also be erected, anchored, and temporarily attached to the building frame or foundation.

10 Air passages connecting the vacuum chambers of each pair of adjoining panels will be drilled through their shared posts.

6. Once the integrated post frame structure of steel plated panels is in place, cross members of lattice frameworks along
15 with fully assembled window panels are installed, beginning at bottom posts of wall panel post frames and working upwards.

When the fully assembled window panels have been positioned within the openings left for them by cross members, the interior washers of clamping assemblies positioned along the post frames of said window panels, an example of which is shown in FIGURE 14,
20 are replaced by the flat washers shown in FIGURE 15 in order to hold the window panels in position against the steel interior plates of the wall panels.

The vacuum chamber of each window panel is connected to that of its host panel by means of a single air passage through its

25 bottom post, and during assembly of said panel, a steel ball is placed in its vacuum chamber, later to be moved by magnet to plug the air passage when the desired degree of vacuum is reached during removal of air.

In all steel plated panels, spheres that maintain separation of plates are hung in slings or otherwise positioned at the centers of squares formed by cross members of the lattice framework in a manner that allows said spheres to roll with any thermally induced expansion or contraction of one plate in relation to the other plate.

7. When lattice frameworks and spheres have been installed in all steel plated panels, exterior steel plates will be pieced together on the same jigs used to assemble interior steel plates and raised into position against their respective post frames. Upon erection of steel exterior plates, clamping assembly washers on the outside perimeters of window panels, as exemplified in FIGURE 14, will be replaced with flat washers as shown in FIGURE 15 in preparation for creating vacuum, thereby holding exterior plates in position until such time as suction pressure of the vacuum serves that purpose.

Also upon erection of steel exterior plates, clamping assemblies will be positioned at one meter intervals along the bottom and top posts of wall panels.

Along the vertical posts of said wall panels at in-turning and out-turning building corners, differing means of compressing plates to post frames, as illustrated in FIGURES 6 and 8, respectively, will be utilized.

On flat or sloping roofs, added weights, if needed, will serve the same purpose as clamping assemblies.

Clamping means and added weights are intended to hold plates sufficiently close to post frames to ensure bonding of plates to post frames when vacuum is applied.

8. Upon activation of the vacuum pump, all plates should immediately bond with their respective post frames in an airtight manner; failure to do so would indicate inadequate clamping.

If a lesser degree of vacuum is intended in glass plated panels
5 than in steel plated panels, the vacuum pump will be deactivated when the lesser degree is attained while steel balls in the vacuum chambers of window panels are moved by magnet to cover the tops of air passages to their host wall panels.

When the positioning of all steel balls has been achieved,

10 reactivation of the vacuum pump will lock the steel balls in place, preventing further increase in vacuum pressure in window panels while pressure is increased in steel plated panels.

When desired pressure is achieved in steel plated panels, the vacuum pump will automatically deactivate, and automatically

15 reactivate if pressure falls to a preset level due to leakage.

Once vacuum is achieved, shims separating panels from the building frame are removed, and all clamping is replaced or modified as necessary in order to permit thermally induced movement of plates.

20 It should be understood that modifications may be made to the embodiments shown in drawings and to any and all aspects of this invention as they have been portrayed in the foregoing text.

PARTS LIST

- 10 Steel plated panel
 - 12 Glass plated panel
 - 14 Post frame or post
 - 16 Steel exterior plate
 - 18 Steel interior plate
 - 20 Glass exterior plate
 - 22 Glass interior plate
 - 24 Vacuum chamber in a steel plated panel
 - 26 Vacuum chamber in a glass plated panel
 - 28 Bolt, attaching the exterior framework component abutting the
footing to the post frame after vacuum has been created
 - 30 Footing
 - 32 Bolt, at an in-turning building corner
 - 34 Bracer, at an in-turning building corner
 - 36 Exterior framework component, at an in-turning building corner
 - 38 Sling
 - 40 Girdle
 - 42 Coil spring
 - 44 Cord, attaching girdle to coil spring
 - 46 Cord, attaching coil spring to a cross member of the lattice
framework
 - 48 Bolt, part of a clamping assembly prior to creating vacuum
 - 50 Nut, part of a clamping assembly
 - 52 Washer, part of a clamping assembly above footing prior to
creating vacuum and around perimeters of window
panels after instalation into wall panels
 - 54 Washer, at the anchor point in a wall panel, preventing
creeping of the exterior plate
 - 56 Steel beam, part of the building frame, abutting the footing
 - 58 Baseboard, removable to access bolts
-

- 60 Building frame
- 62 Shim, separating the exterior framework component and the
steel exterior plate at a building corner
prior to creating vacuum
- 64 Shim, separating a wall panel from the building frame prior
to creating vacuum
- 66 Steel pillar, part of the building frame at an in-turning
building corner
- 67 Cornerpiece, removable to access bolts
- 68 Air passage, connecting the vacuum chambers of two adjoining
panels
- 70 Bolt, at an out-turning building corner prior to creating
vacuum
- 72 Bolt, at an out-turning building corner after vacuum has been
created
- 74 Exterior framework component at an out-turning building corner
- 76 Bracer, at an out-turning building corner
- 78 Steel pillar, part of the building frame at an out-turning
building corner
- 80 Washer, part of a clamping assembly under an eave prior to
creating vacuum and around the perimeter of a window
panel before instalation into a wall panel
- 82 Steel beam, part of the building frame under an eave
- 84 Exterior framework component under an eave
- 86 Steel girder, part of the building frame, at top of a bearing
wall supporting a flat roof
- 88 Exterior framework component on a flat roof
- 90 Exterior framework component, covering the bottom edge of a
wall panel, abutting the footing
- 92 Bolt, anchoring roof panels to the building frame at midpoint
of a flat roof
- 94 Bolt, anchoring roof panels to the building frame at midpoint
of the peak line on a sloping roof
- 96 Exterior framework component, covering the peak line on a
sloping roof

- 98 Steel girder, part of the building frame, at top of a bearing wall supporting a peak roof
- 100 Bolt, attaching an outer window frame to a window panel post frame
- 102 Outer window frame
- 104 Interior window casing
- 106 Lattice framework or cross member of same, within the vacuum chamber of a steel plated panel
- 108 Lattice framework or cross member of same, within the vacuum chamber of a glass plated panel
- 110 Thickened portion of a cross member in a glass plated panel
- 112 Sphere, separating the plates in a steel plated panel
- 114 Projection, at an intersection of cross members of the lattice framework in a steel plated panel

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A vacuum insulated building panel, a number of which are needed to cover the outside of a particular building, one such
5 panel fitting over each plane surface or part thereof of the building other than over window openings, each such panel consisting of
 - a rigid air impervious interior plate and a similar rigid air impervious exterior plate juxtaposed to each other but
10 separated at their outer edges by a thermally nonconductive air impervious post frame, the material of the post frame being plastic or wood, the post frame consisting of a separate post along each straight section of the post frame, the separate posts of the post frame being joined at their ends, the basic cross
15 section of a post of the post frame being square when serving a single post but with a flange added for each panel when serving two abutting panels that cover different plane surfaces, such a modification in the shape of posts being made wherever two steel plated panels abut which enables each such pair of abutting panels
20 to be served by a single post, thereby unifying the post frames of all such panels into a single contiguous structure, the plates being made of steel sheeting, the post frame being overlaid on each side by one of the plates, the plates being attached to the post frame solely by suction when the panel is under vacuum
25 except that at a single location a bolt maintains the relative positions of post frame and plates to each other, the plates being clamped to the post frame when the panel is not under vacuum

during construction or when vacuum is released for servicing or lost due to accident,

5 a vacuum, which is created in an enclosure forming a vacuum chamber, the vacuum chamber being formed by the post frame and the interior and exterior plates, the vacuum within being created when air is withdrawn from the vacuum chamber by means of a vacuum pump, the vacuum creating a suction pressure on the inside faces of the post frame and the two plates that is countered, respectively, by a lattice framework which supports
10 the post frame and by a system of equally spaced spheres which support the two plates against the suction pressure of the vacuum, a degree of vacuum being attained that reduces the transfer of heat or coldness through the panel in proportion to the percentage of air withdrawn from the vacuum chamber,

15 a vacuum pump which is connected either directly to all steel plated panels covering a building by means of a pipe grid connecting said pump to an access port through the interior plate of each said panel or indirectly by means of at least one air passage through the shared post of each pair of abutting
20 steel plated panels, and which, upon activation, creates vacuum in such panels to the degree desired, then maintains that degree of vacuum by reactivating automatically to restore any pressure lost due to leakage of air into vacuum chambers,

a system of equally spaced clamping assemblies following
25 the outer edges of each steel plated panel covering a wall, the said assemblies holding the interior and exterior plates of each such panel in close proximity to its post frame in preparation

for creating vacuum so that when vacuum is applied, said plates immediately bond with their post frame in an airtight manner, and

an exterior framework which includes components that cover the outer edges of all vertical standing panels, preventing the collapse of such panels at such times as vacuum is lost due to accident or released for servicing purposes,

wherein the problem of warping in other vacuum panels, which is caused by thermally induced expansion and contraction of the weather exposed exterior faces of such panels while the interior faces remain relatively unchanged in size or shape due to being maintained at close to the constant temperature inside the building, is eliminated in the present panel by using the suction pressure of the vacuum as the sole means of attachment between the post frame and the interior and exterior plates other than by a bolt that prevents creeping of said parts in relation to each other, thereby permitting either plate to alternately expand and contract away from and toward, respectively, said bolt by sliding over the post frame without forcing an accompanying movement of said post frame and without threatening the airtight bonds between said post frame and plates.

2. A vacuum insulated building panel as defined in Claim 1

wherein space to accommodate thermally induced expansion and contraction of plates away from and toward, respectively, the bolt that anchors the plates to the post frame in a steel plated panel is provided along the outer edges of said plates, thereby permitting said plates to expand and contract to their

maximums in hot and cold temperatures without encountering obstruction or losing adequate contact with said post frame.

3. A vacuum insulated building panel as defined in Claim 1

wherein a means of maintaining the separation of interior
5 and exterior plates in steel plated panels against the suction
pressure of the vacuum is provided in the form of spheres which
roll in sympathy with any expansion or contraction that occurs
in one of the plates but not the other, thereby relieving stress
that would be imposed by a rigid means of maintaining plate
10 separation.

4. A vacuum insulated building panel as defined in Claim 1

wherein the spheres that maintain the separation of plates
in steel plated panels are each contained in a sling which holds
it in its proper position when the panel is not under vacuum and
15 permits it to roll in response to thermally induced expansion or
contraction that occurs in one plate of the panel but not in the
other plate when the panel is under vacuum, each sling consisting
of a girdle which loosely encircles each sphere and is attached
by cord or wire in opposite directions that line up with the
20 anchor point of the panel firstly to a coil spring in each said
direction and thereafter to crossmembers of the lattice framework.

5. A vacuum insulated building panel as defined in Claim 1

except that the plates are made of glass so that the panel
functions as a window, such panel being referred to herein as a
25 window panel

wherein cross members of the lattice framework are more

narrow and more closely spaced than in steel plated panels, and said cross members are modified in shape so that they counter the suction pressure of the vacuum on the plates as well as on the post frame,

5 wherein the window panel is incorporated within a steel plated wall panel, the latter being referred to herein as the host wall panel, the window panel and the host wall panel sharing a post frame that is separate from the integrated post frame structure of the building, the posts of the post frame being
10 modified in shape to accommodate the increased thickness of glass plates and to provide barriers to prevent creeping of plates, and

 wherein a single air passage at midpoint of the bottom post of said post frame connects the vacuum chamber of the window
15 panel to that of the host wall panel and a steel ball within the vacuum chamber of the window panel is moved during creation of vacuum by means of a hand held magnet to cover and plug the air passage, thereby preventing further increase in pressure in the window panel in consideration of its more fragile plate material
20 while permitting increased removal of air from the host wall panel.

FIG. 1/21. Scale: 1 = 10.

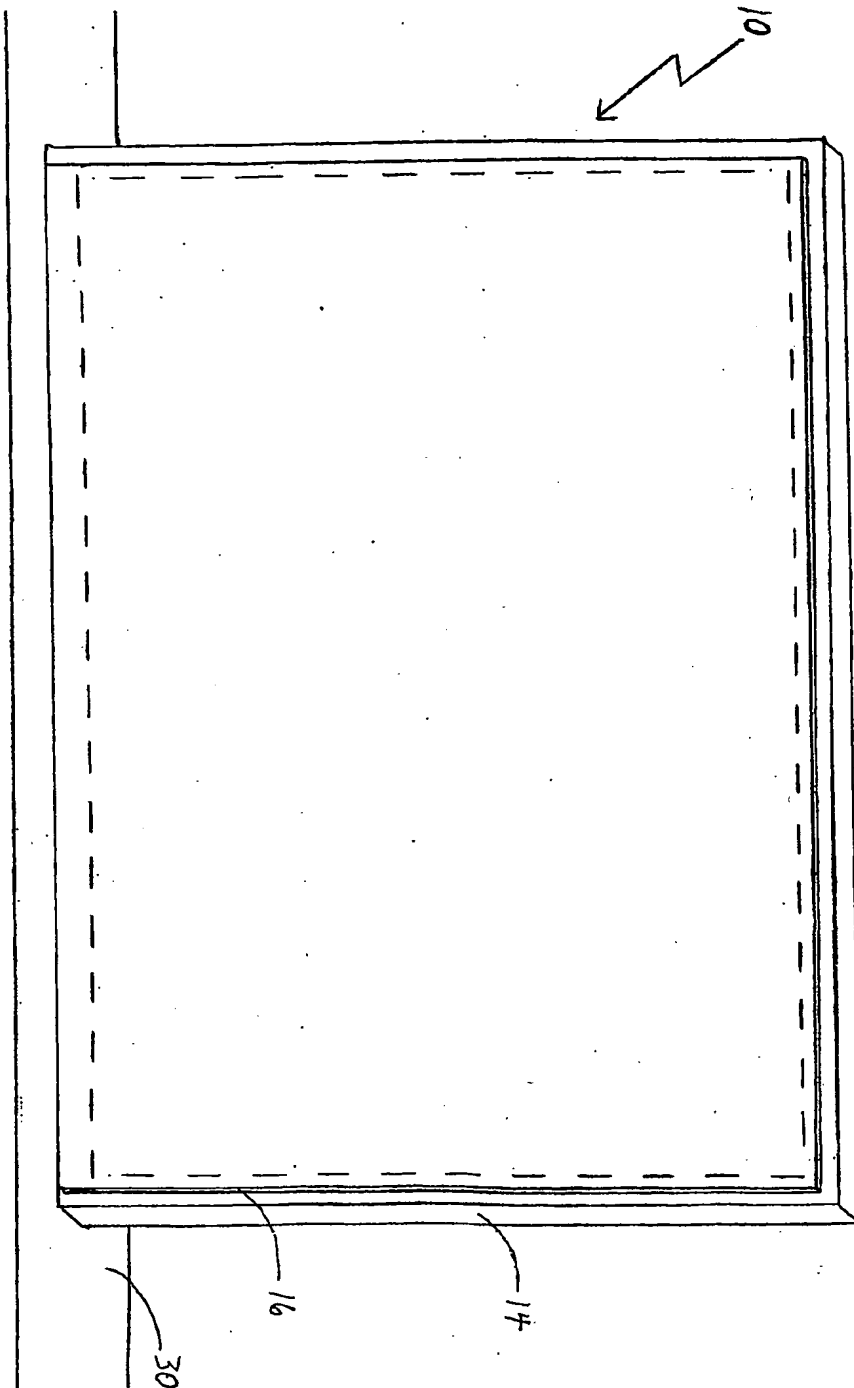


Fig. 2/21. Full scale.

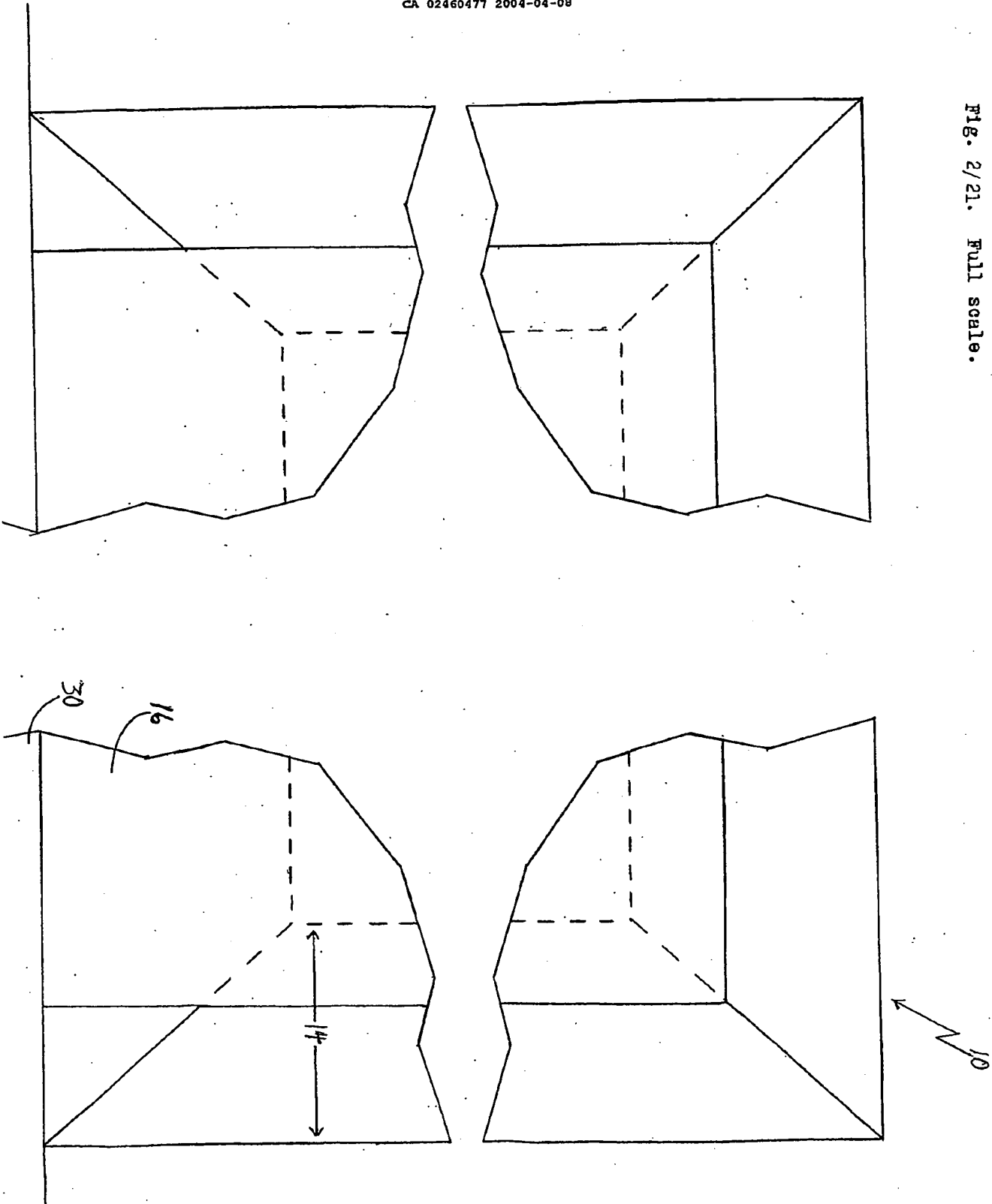
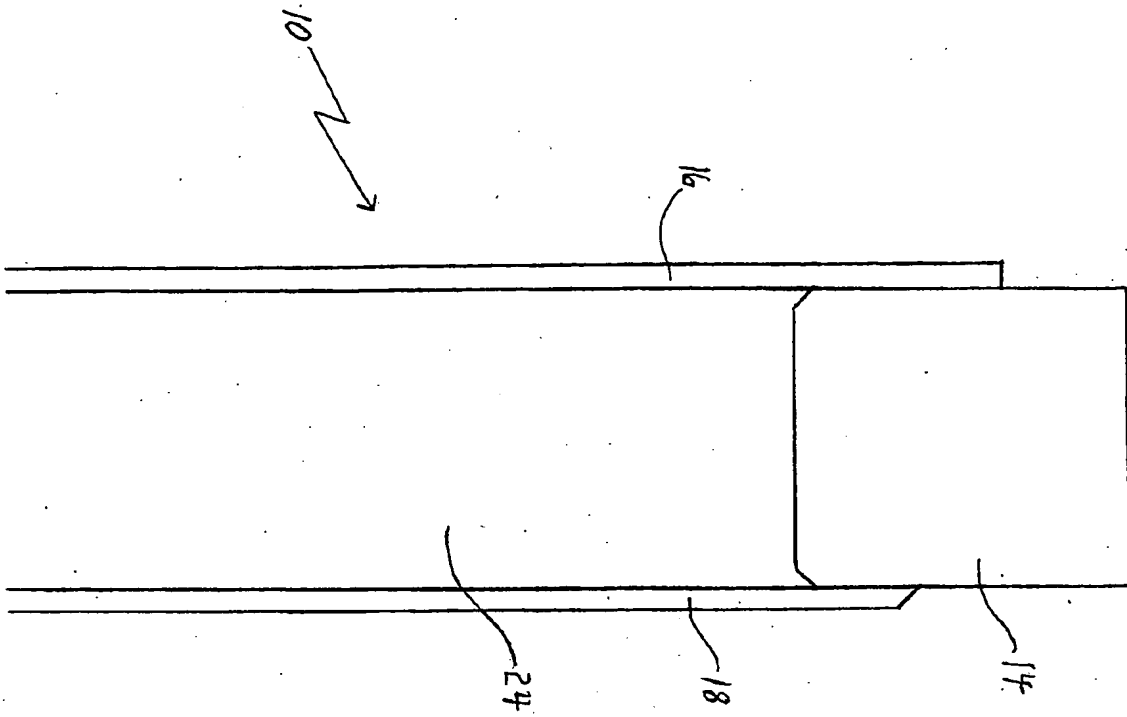


Fig. 3/21. Full scale.



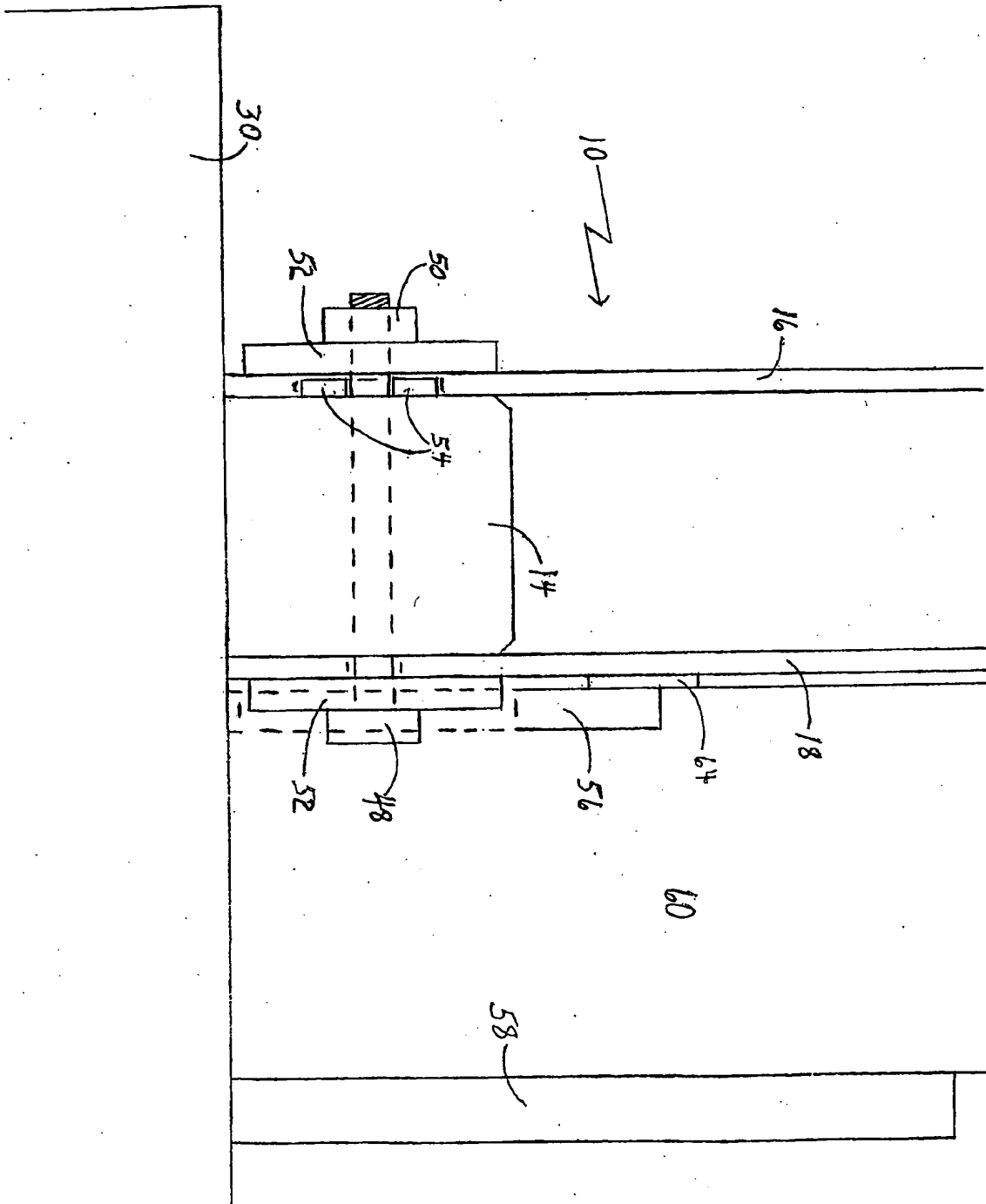


FIG. 5/21. Full scale.

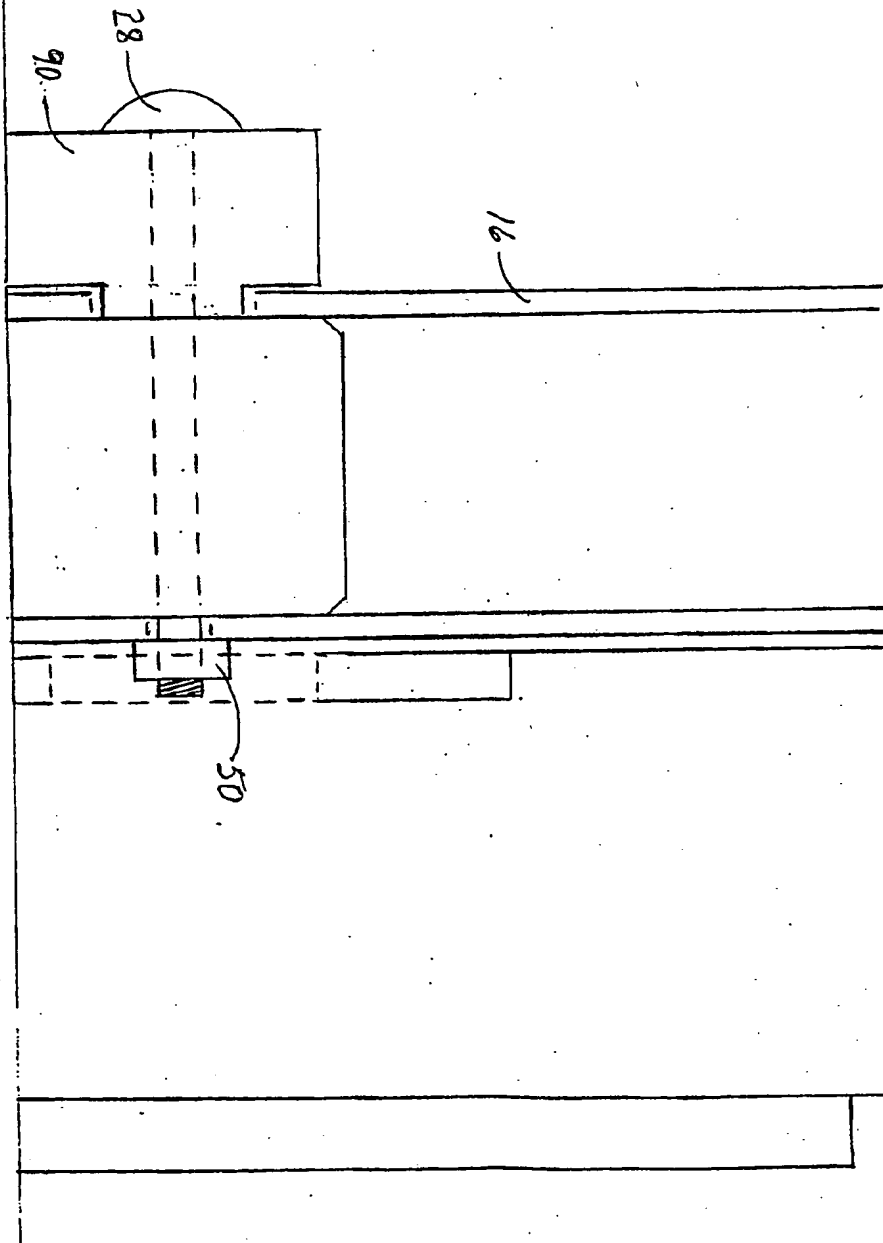


Fig. 6/21. Full scale.

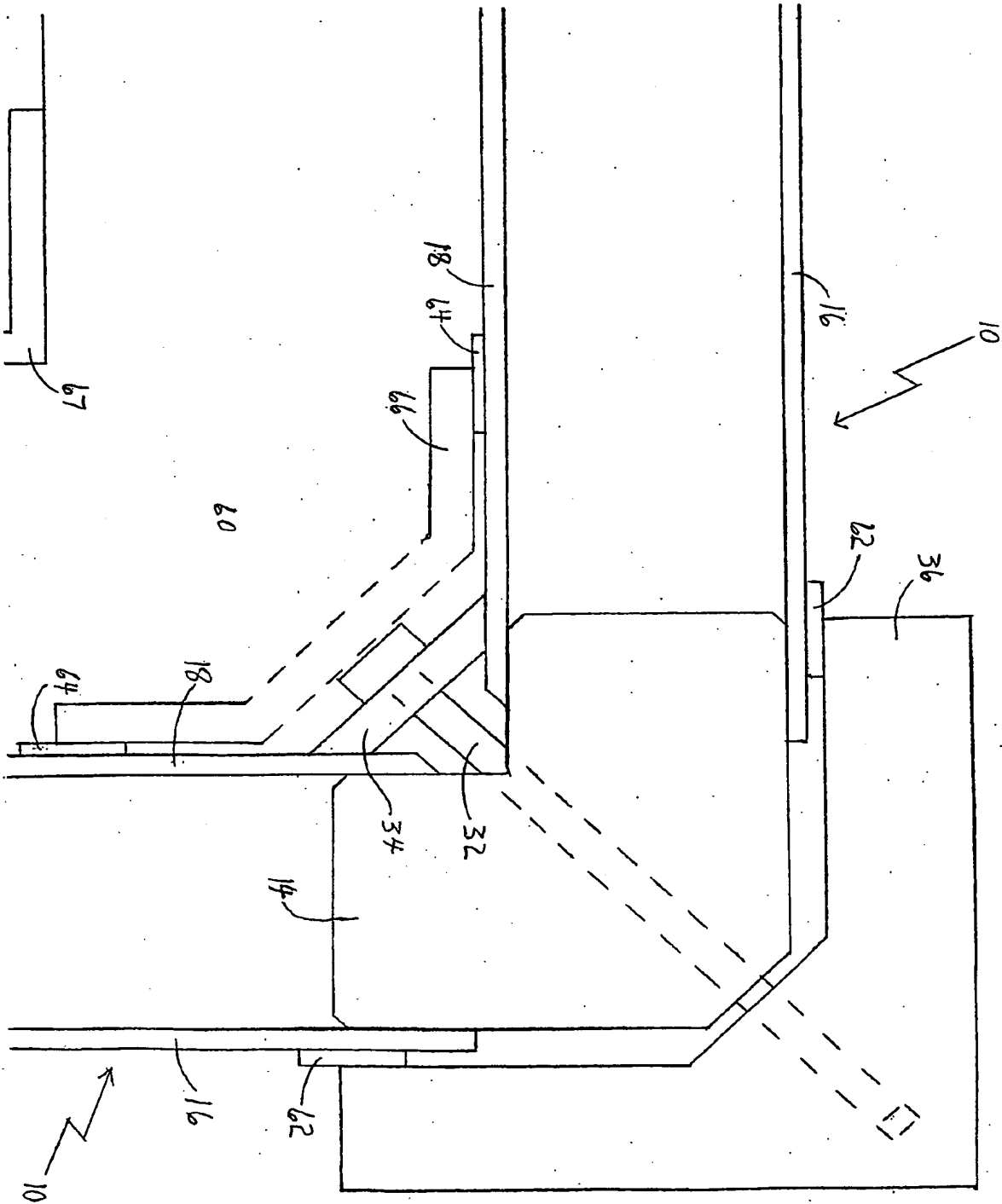


Fig. 7/21. Full scale.

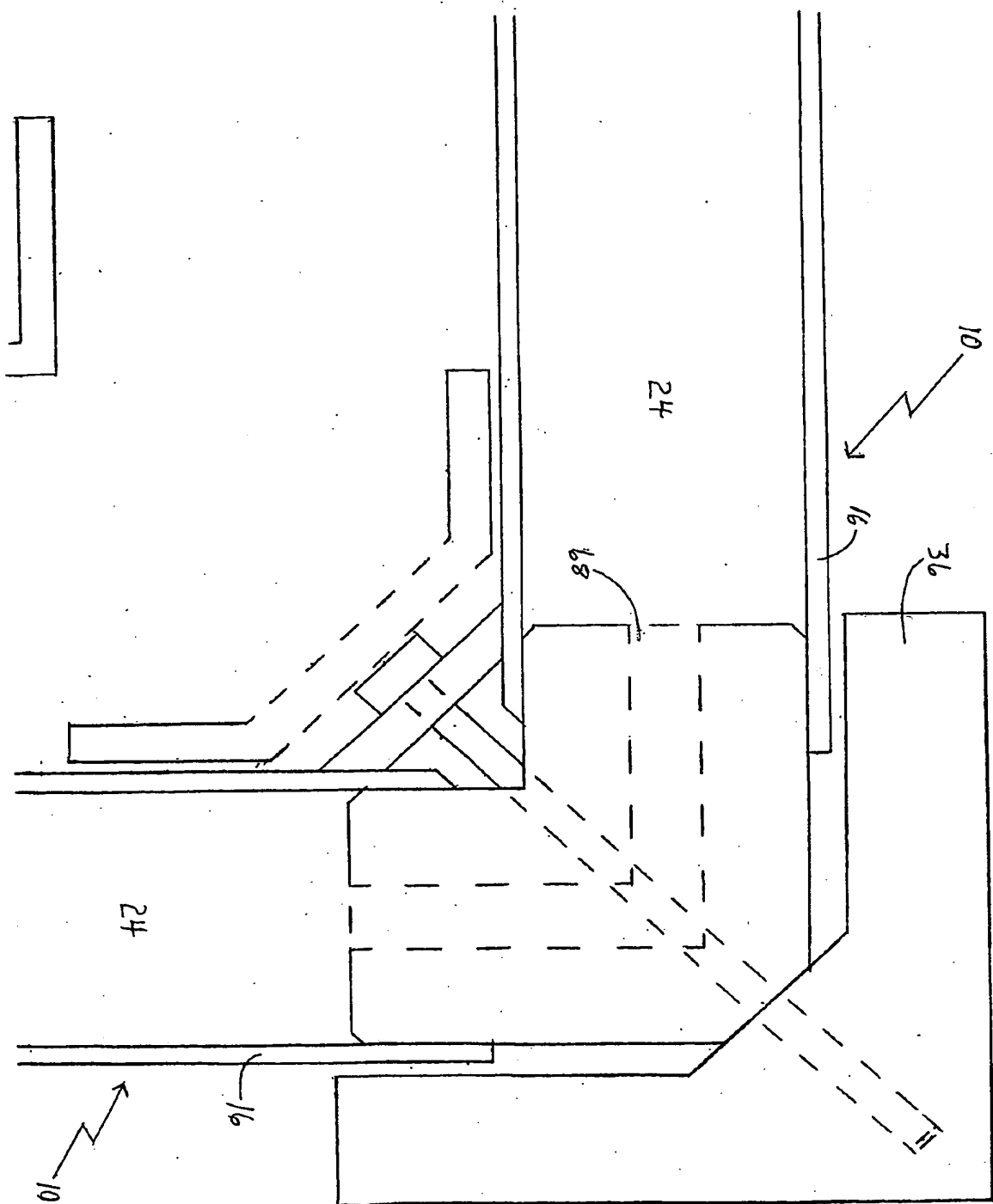


FIG. 8/2L Full scale.

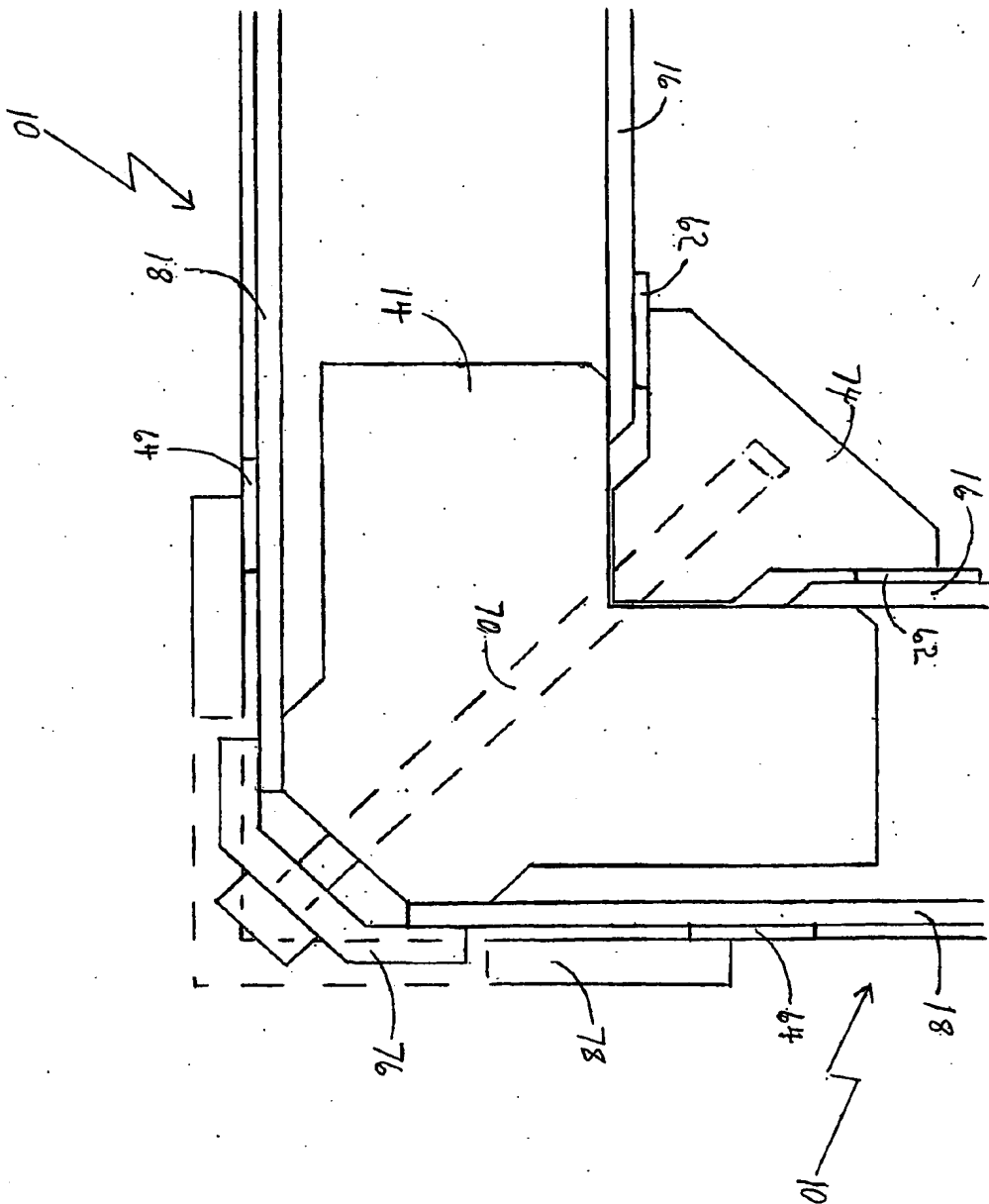


Fig. 9/21. Full scale.

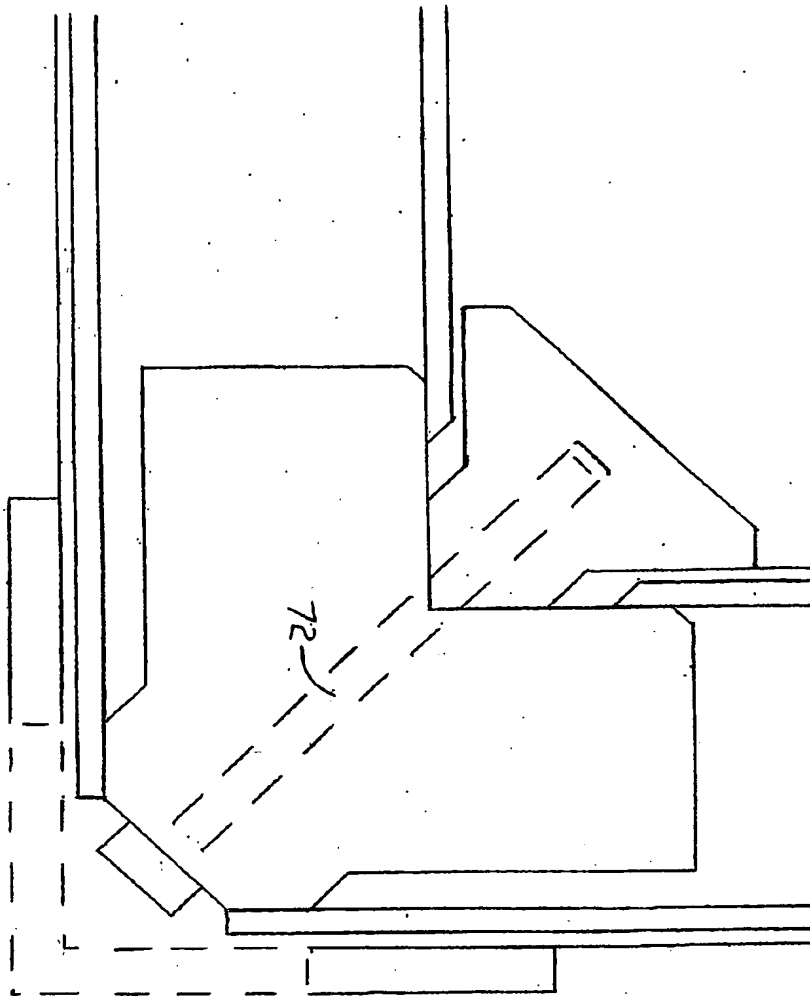


Fig. 10/21. Full scale.

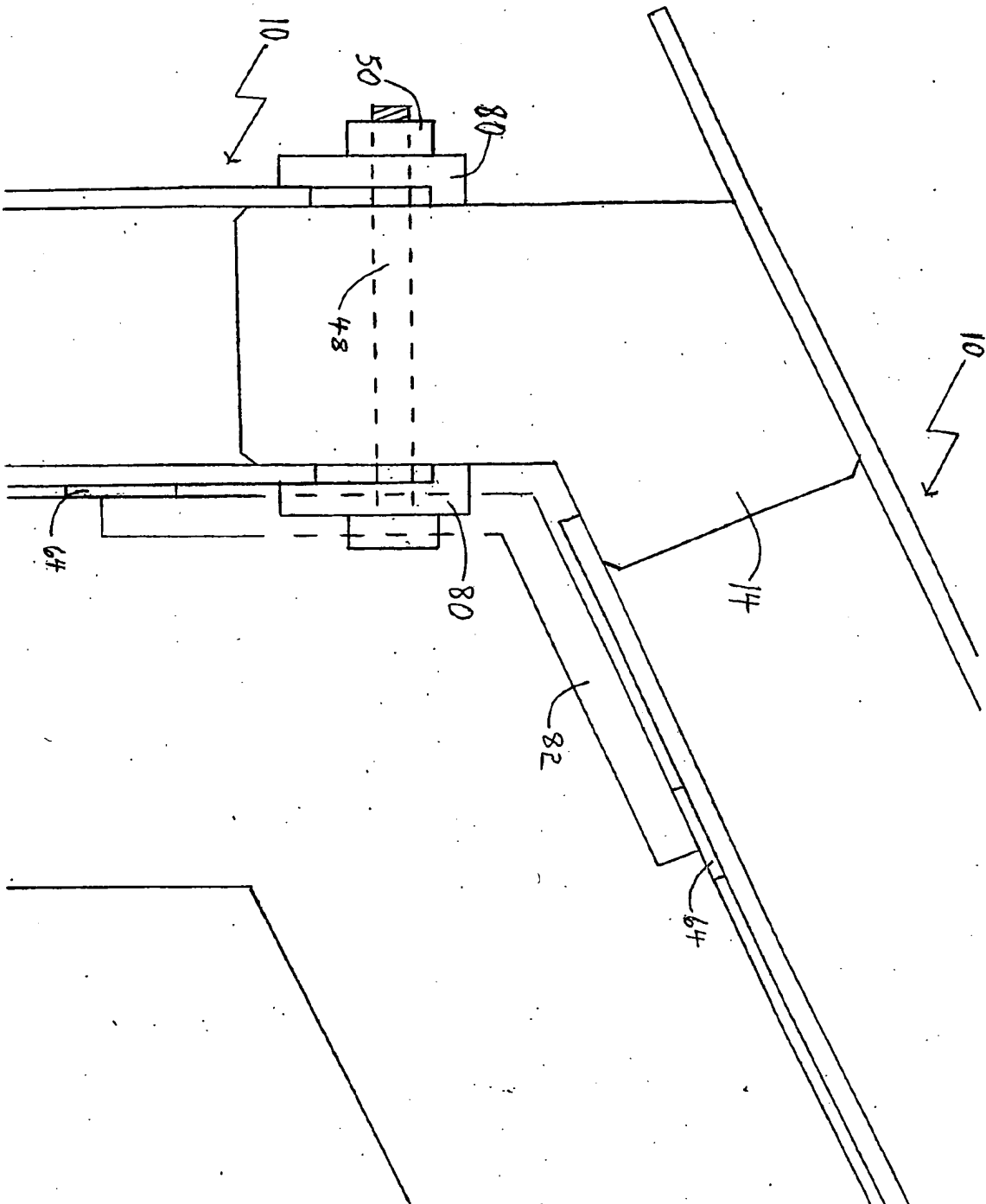


Fig. 11/21. Full scale.

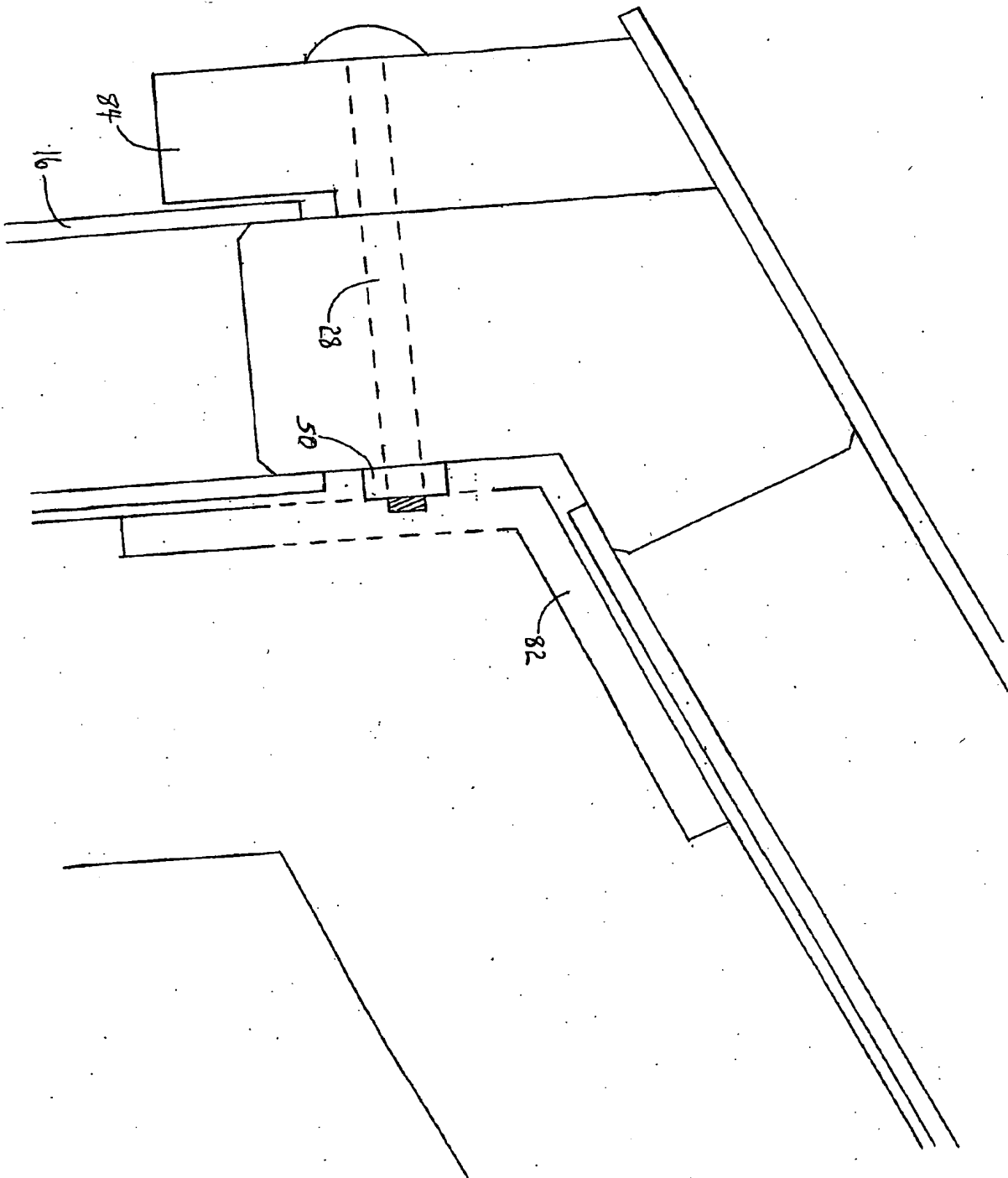


Fig. 12/21. Full scale.

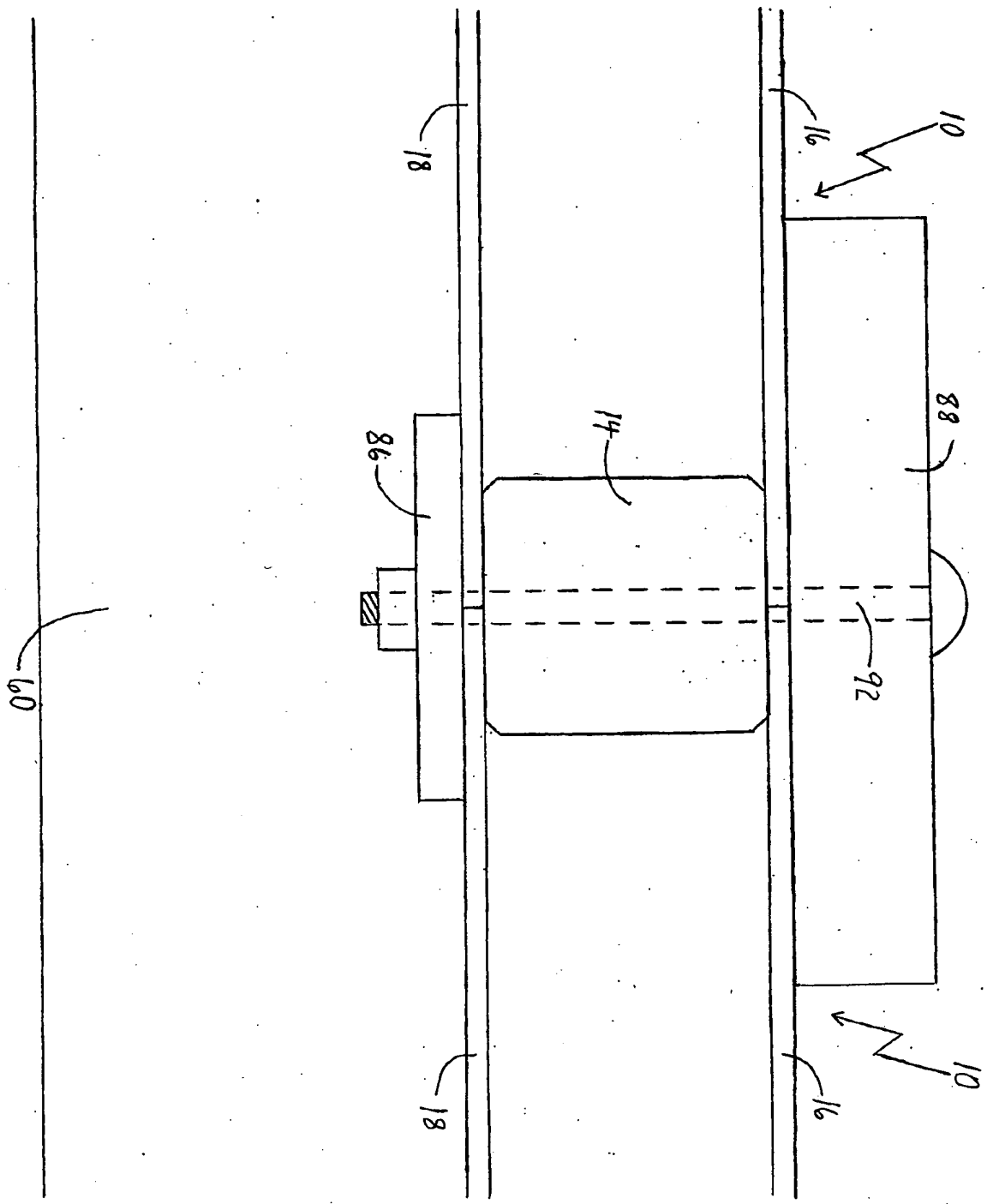


Fig. 13/21. Full scale.

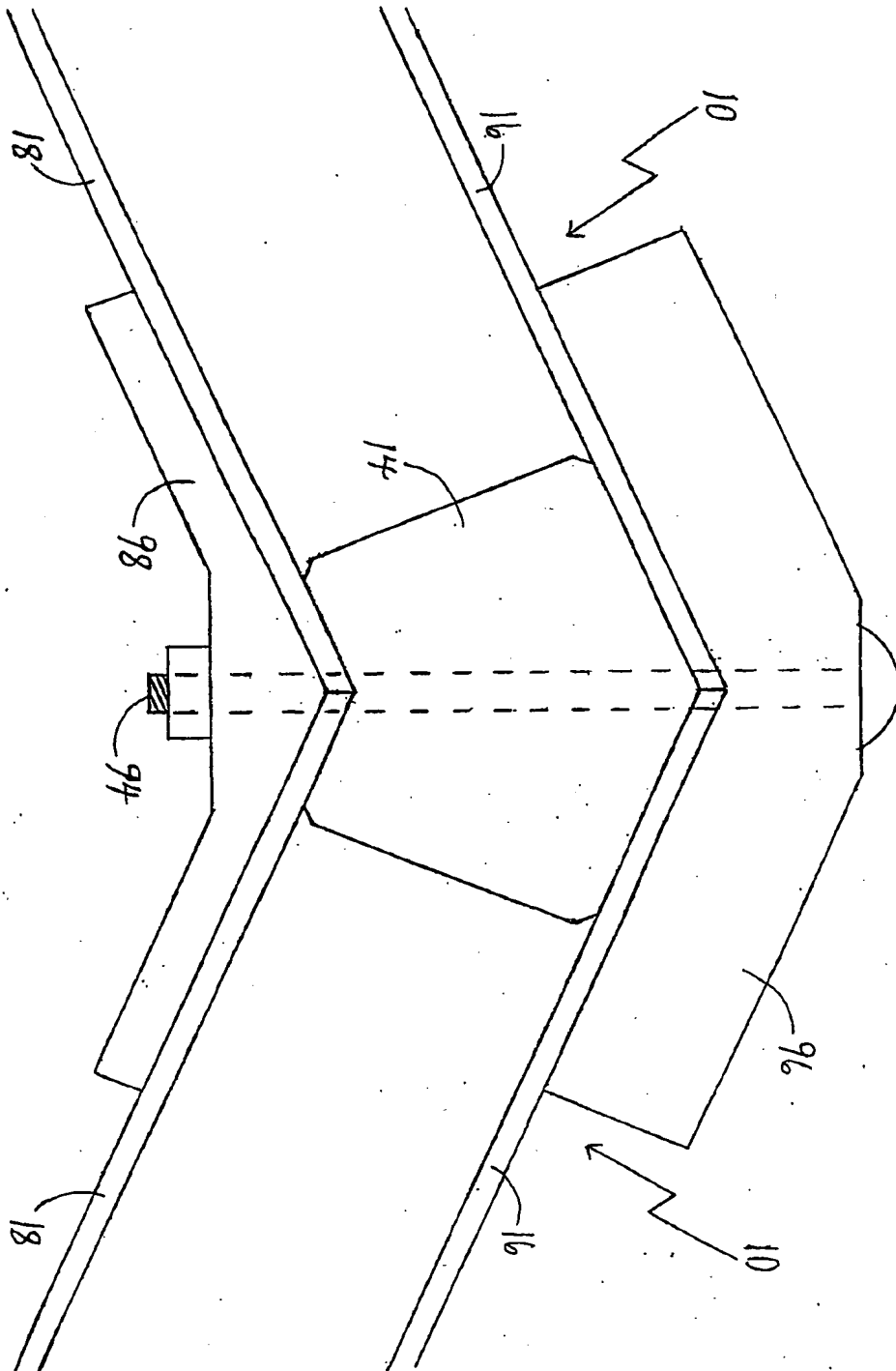


Fig. 14/21. Full scale.

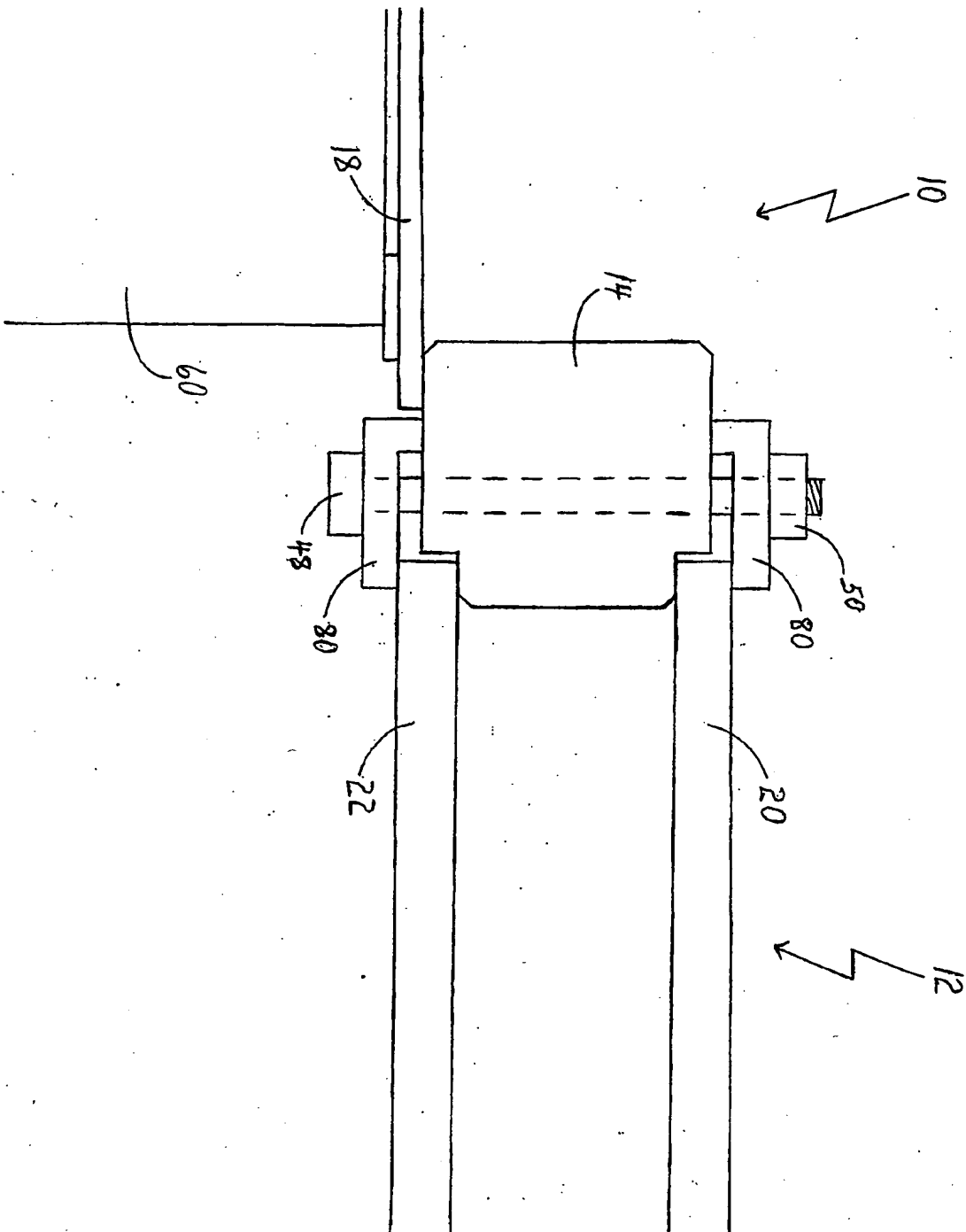


Fig. 15/21. Full scale.

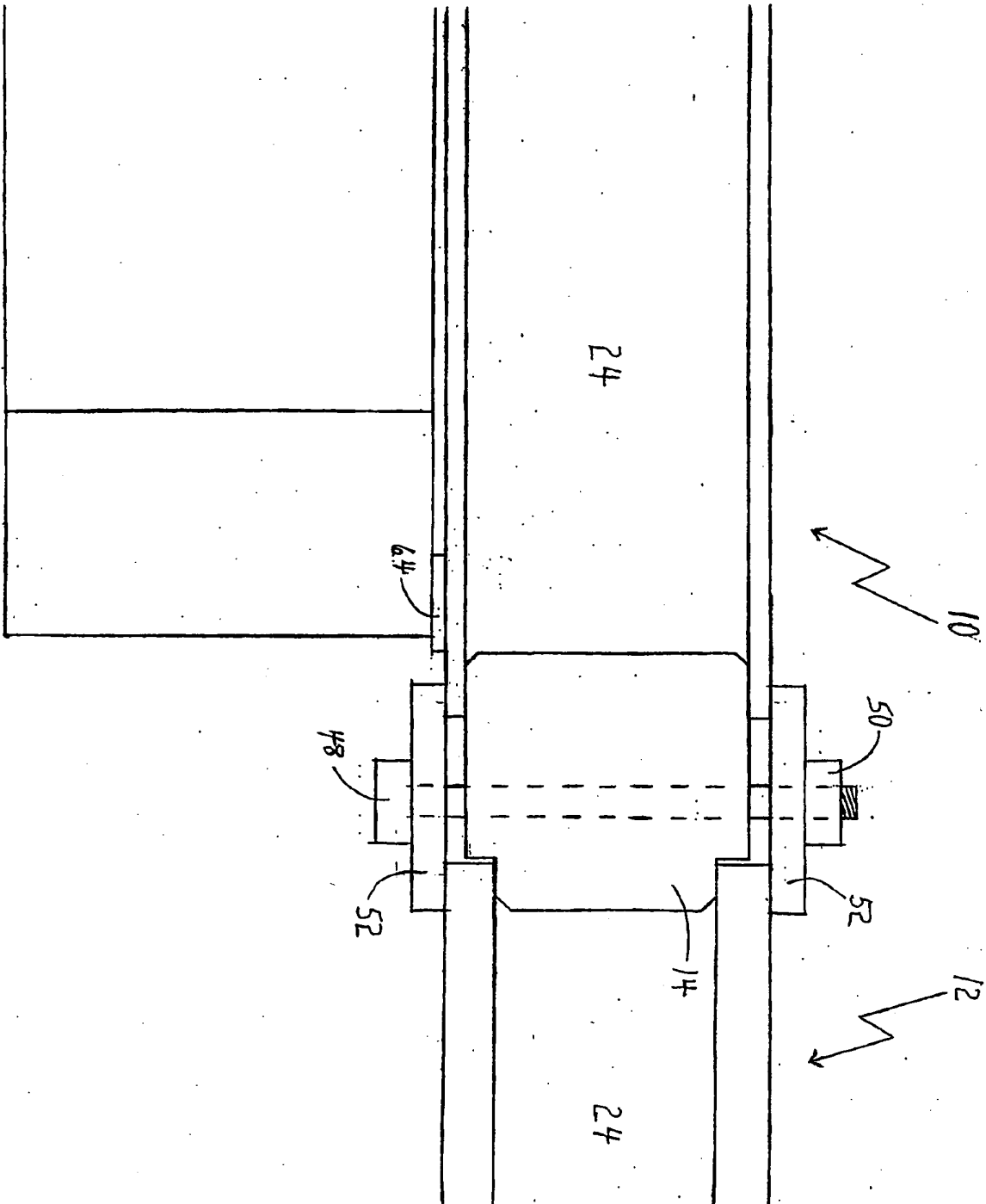


FIG. 16/21. Full scale.

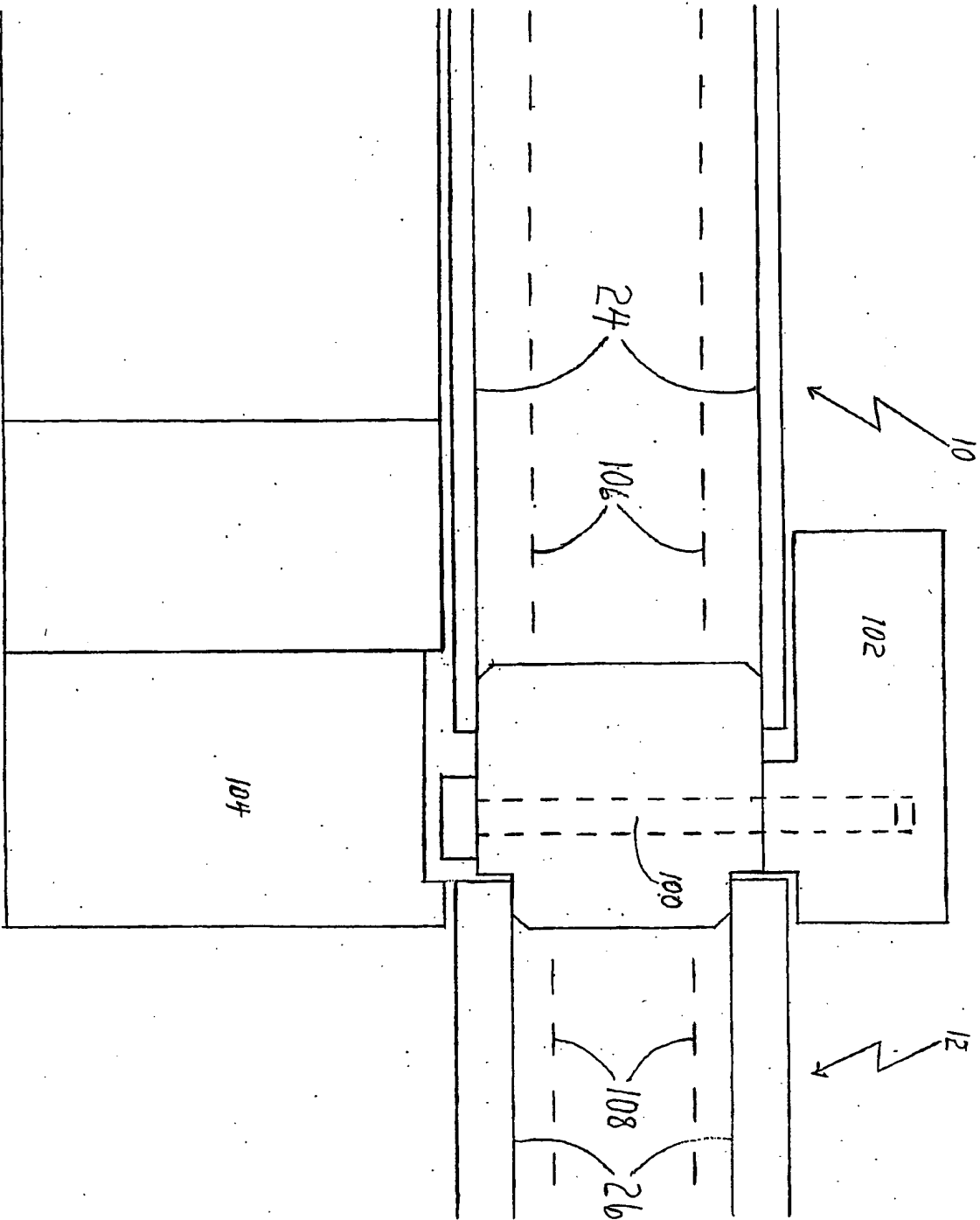


Fig. 17/21. Scale: 1 = 10.

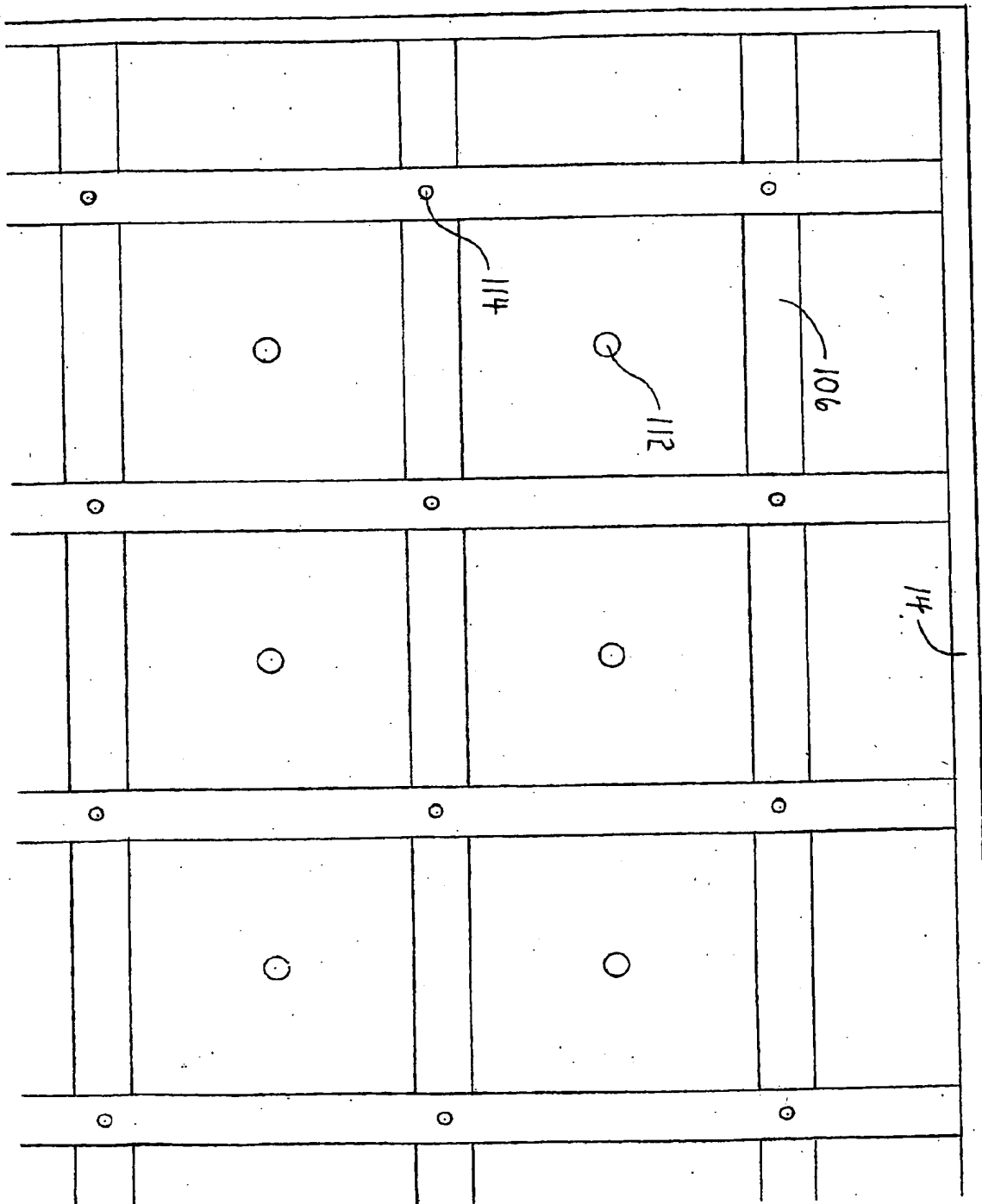


FIG. 18a/21. Scale: 1 = 3.

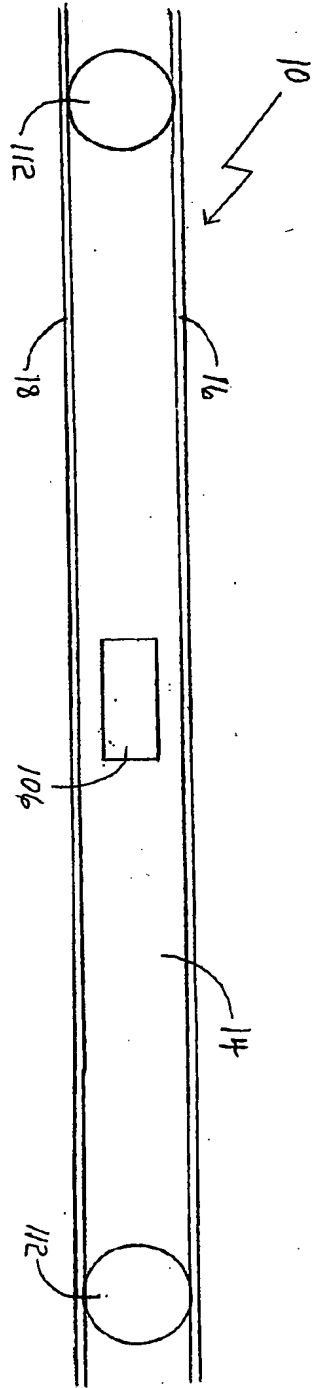


FIG. 18b/21. Scale: 1 = 3.

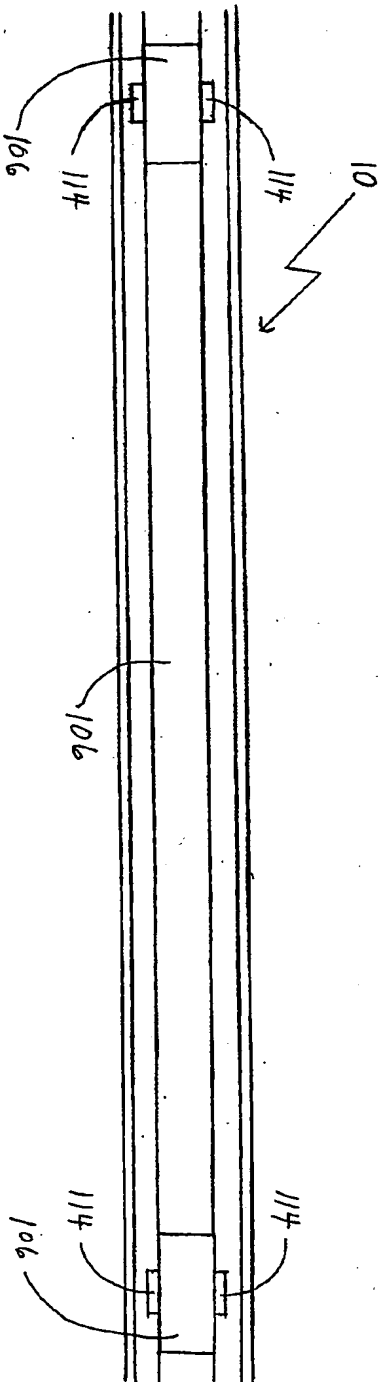


FIG. 19/21. Scale: 1 = 5.

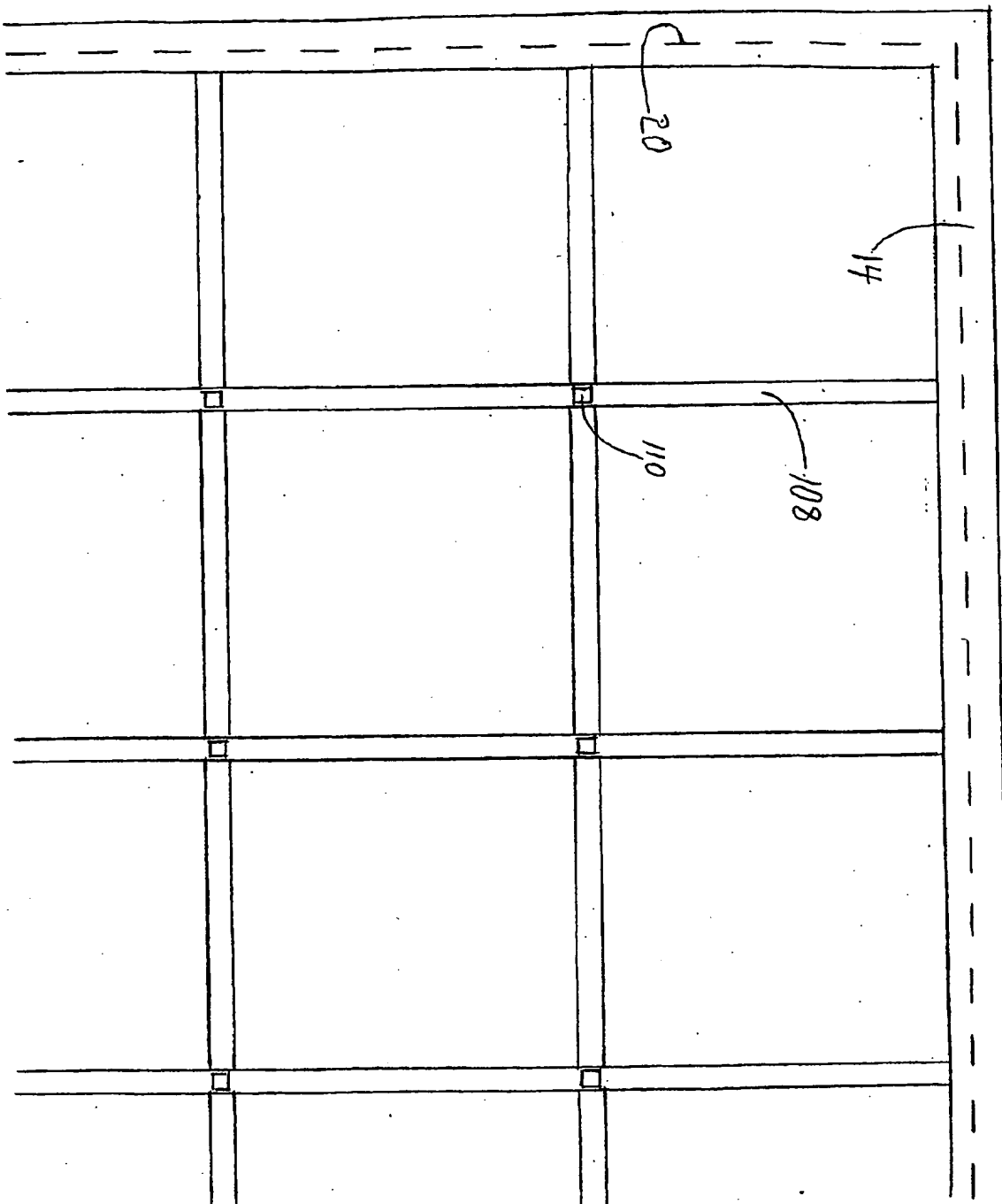
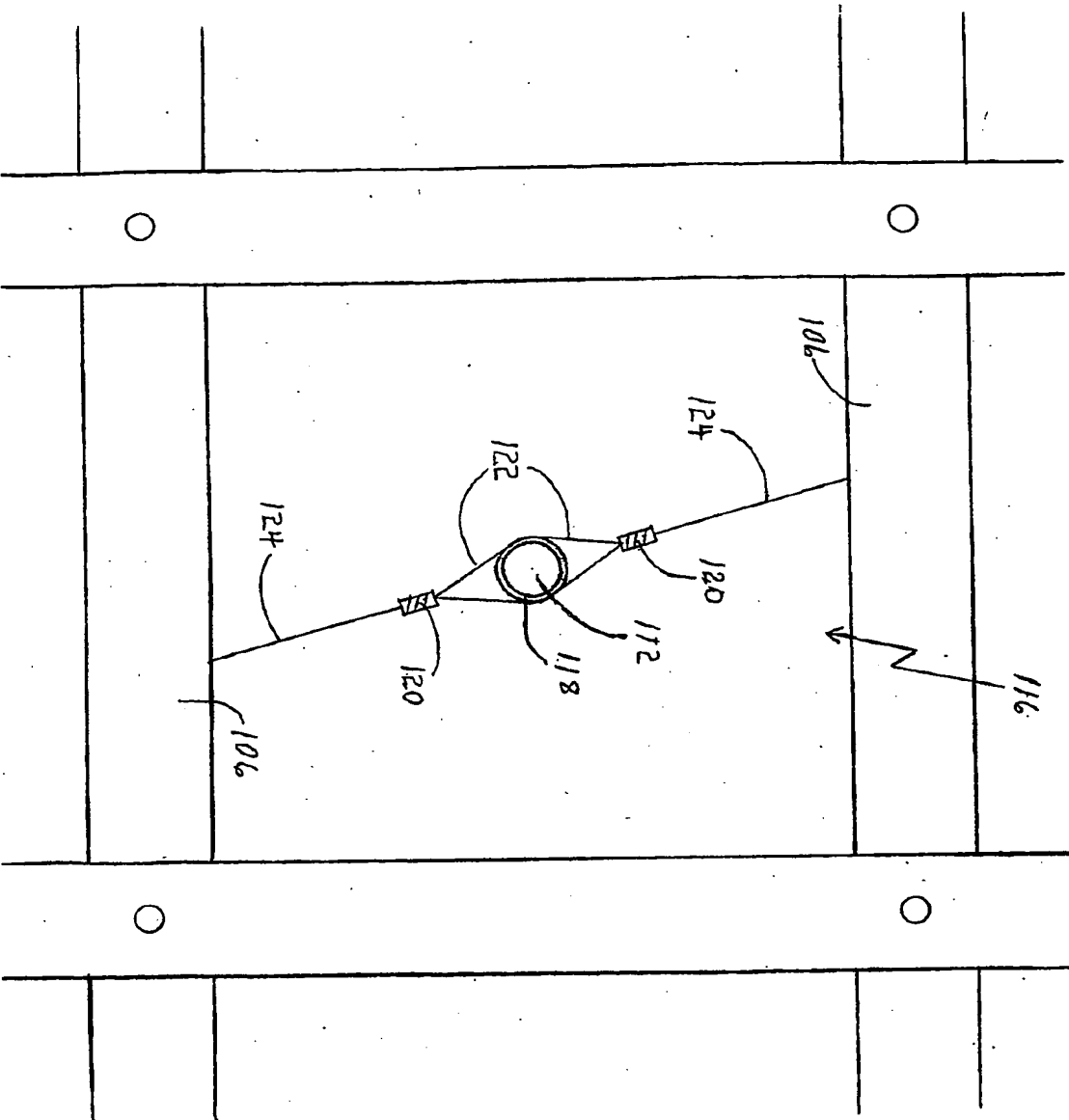


Fig. 21/21. Scale: 1 = 5.



From the INTERNATIONAL BUREAU

PCTNOTIFICATION CONCERNING
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FLEMING, Wallace, E.
#1005, 10160 - 116 Street
Edmonton, Alberta T5K 1V9
CANADA

(PCT Administrative Instructions, Section 411)

| | |
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| Date of mailing (day/month/year) 29 June 2005 (29.06.2005) | |
| Applicant's or agent's file reference not available | IMPORTANT NOTIFICATION |
| International application No. PCT/CA2005/000645 | International filing date (day/month/year) 01 April 2005 (01.04.2005) |
| International publication date (day/month/year) | Priority date (day/month/year) 08 April 2004 (08.04.2004) |
| Applicant FLEMING, Wallace, E. | |

- By means of this Form, which replaces any previously issued notification concerning submission or transmittal of priority documents, the applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to a date of receipt, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
- (If applicable)* The letters "NR" appearing in the right-hand column denote a priority document which, on the date of mailing of this Form, had not yet been received by the International Bureau under Rule 17.1(a) or (b). Where, under Rule 17.1(a), the priority document must be submitted by the applicant to the receiving Office or the International Bureau, but the applicant fails to submit the priority document within the applicable time limit under that Rule, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
- (If applicable)* An asterisk (*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b) (the priority document was received after the time limit prescribed in Rule 17.1(a) or the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b)). Even though the priority document was not furnished in compliance with Rule 17.1(a) or (b), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as the priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

| Priority date | Priority application No. | Country or regional Office or PCT receiving Office | Date of receipt of priority document |
|----------------------------|--------------------------|---|---|
| 08 April 2004 (08.04.2004) | 2,460,477 | CA | 24 June 2005 (24.06.2005) |

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